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# WAR MACHINE

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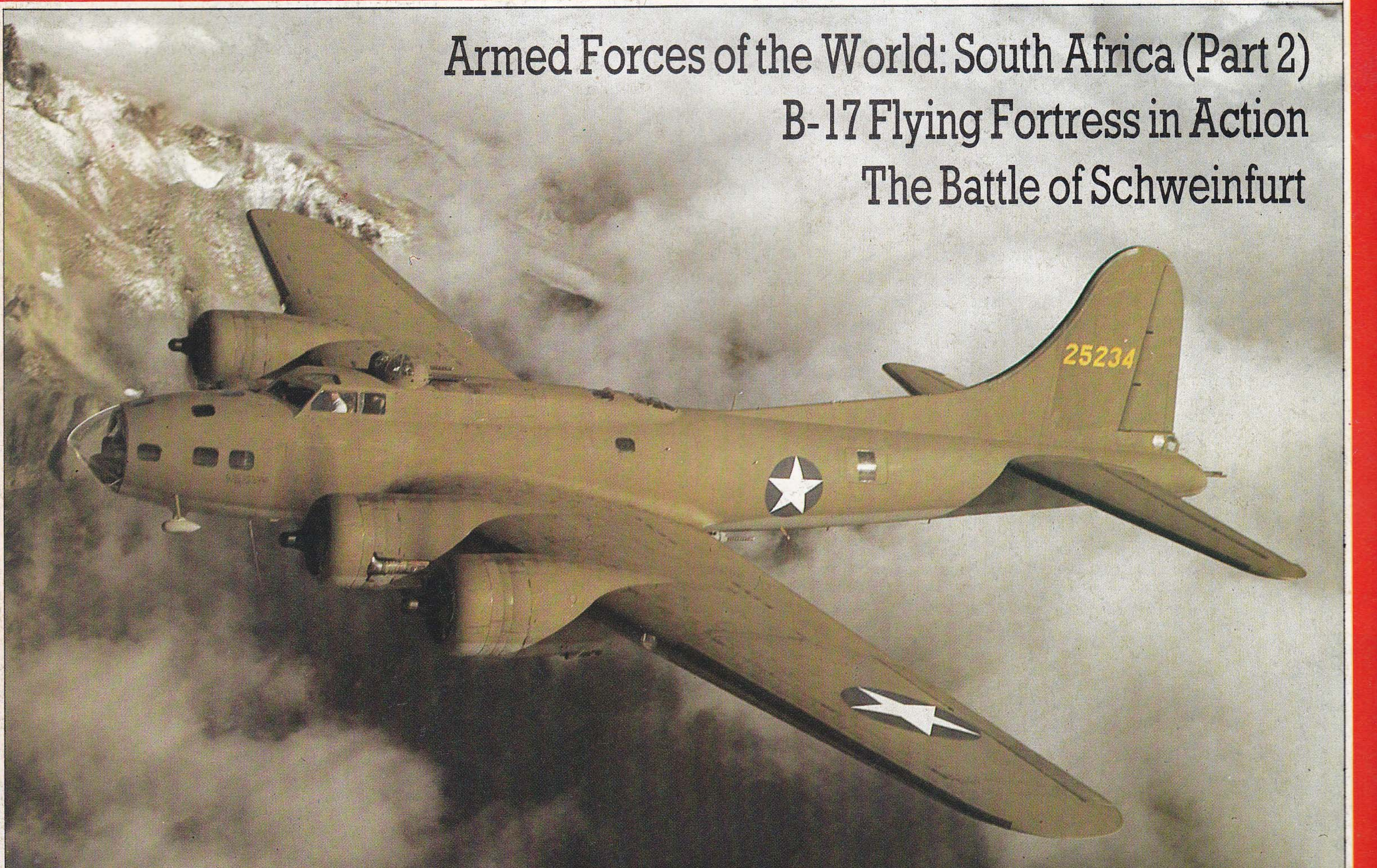

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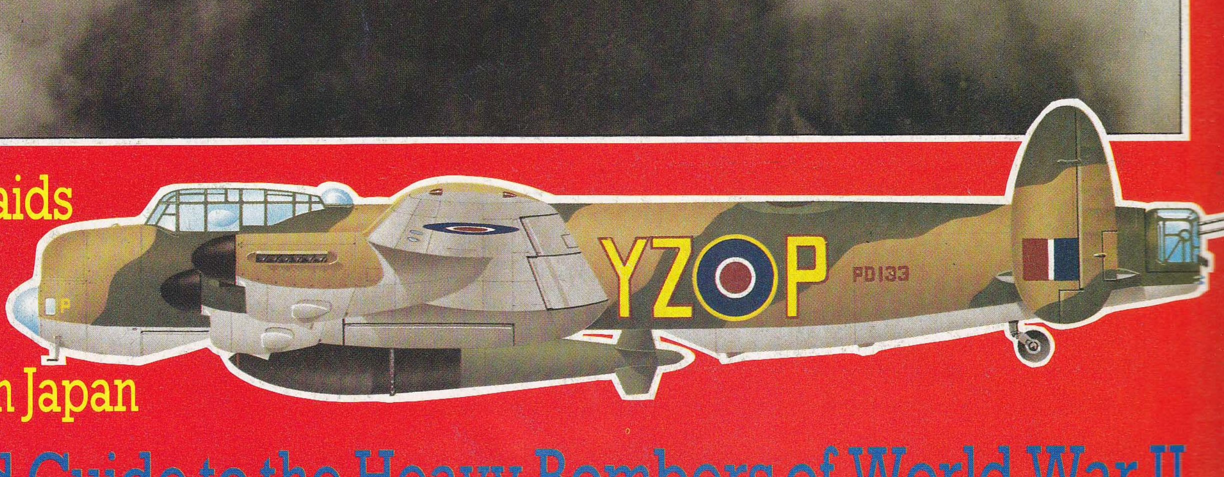

## An Illustrated Guide to the Heavy Bombers of World War II

# WAR MACHINE

Volume 1 Issue 8

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**WAR MACHINE**

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# Heavy Bombers of World War 11

***American general Billy Mitchell had predicted that large forces of heavy bombers could alone win a war. His ideas were slow in being transformed into aircraft, but eventually mighty new warplanes took to the skies. Great dramas unfolded as the enemies set out to destroy each other's homelands.***

*Prewar Germany produced fast and agile bombers such as these Heinkel 111s rather than heavy, slow and cumbersome types. The policy produced dramatic results in the early war years, but she was unable to match the colossal devastation wrought by the Allied heavies later on.*

When Hitler embarked on his subjugation of Europe, the Luftwaffe's role was largely confined to providing air support for the German army, with little emphasis laid upon the use of strategic bombers, plans for such a force having been abandoned in 1937. Thus at the outbreak of war in September 1939 the Luftwaffe's bombing arm comprised excellent medium bombers (the Dornier Do 17, Heinkel He 111 and Junkers Ju 88) which were regarded as adequate for the task of defeating Europe, a task expected to occupy no more than three years. With little to fear from opposing fighters, these aircraft also proved perfectly capable of carrying out daylight raids well beyond the advancing German armies.

The Royal Air Force, on the other hand, was steeped in the bomber tradition, recognizing the potential war-winning role of the bomber, and went to war with a trio of medium/heavy bombers (the Vickers Wellington, Armstrong Whitworth Whitley and Handley Page Hampden) in which a much greater emphasis had been laid on long range, giving rise to some pretence at strategic operation from the outset.

However, the manner in which the fortunes of war changed for Germany (starting with her inability to crush the UK during the summer of 1940) brought about a progressive reassessment of the Luftwaffe's capacity to carry the air war beyond the English Channel, and the night Blitz of 1940-1 represented an unpremeditated use of its relatively small bombers for strategic purposes and, in view of the UK's wholly inadequate night defences, these achieved far more by night than had proved possible by day. But the proliferation of battlefronts in 1941 forced a dispersal of the German bombers away from the Channel and, as a result of growing demands for fighters and ground support aircraft, the Luftwaffe's bomber force henceforth declined both in strength and relative quality.

Meanwhile RAF Bomber Command was, in 1941, reaping the harvest from the strategic seeds sown in 1936 with the arrival on operations of the Short Stirling and Handley Page Halifax four-engine heavy bombers, later joined by the magnificent Avro Lancaster, all of which had been conceived as dedicated long-range strategic night heavy bombers. Thereafter the strength of the British heavy bomber force increased steadily throughout the war. In 1942 Bomber Command was joined by the United States' mighty 8th Air Force, whose Boeing B-17s and Consolidated B-24s were to hit Germany by day in ever-growing strength in partnership with the RAF.

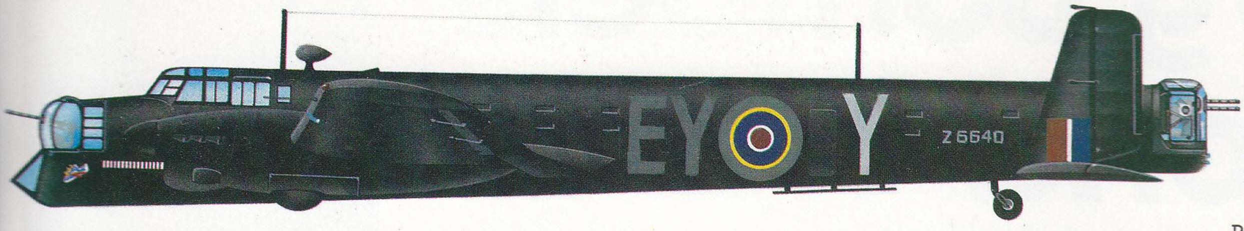
Thus by the time the Allies were ready to set foot on continental Europe in mid-1944 their day and night bomber fleets were capable of delivering devastating blows far beyond the ground battle, inflicting appalling damage on the enemy's capacity to sustain his war machine. By contrast Germany, beset on all sides in the air and on the ground, had largely forsaken its bomber force, preferring to accord priority to the production of fighters with which to defend the Reich.

The fateful decision by Germany to abandon plans for a true strategic bomber force long before the war, while fatally compromising the Luftwaffe's ability to strike at long range, was in all probability superfluous in the eventual context of World War II. Such a force, operating radially from within continental Europe, could never have matched the potential strength of the Allies' massive resources, dispersed as they were peripherally to strike diametrically across *Festung Europa*.

***America transformed the war with her big ideas and enormous industrial effort. Nowhere was this expressed more spectacularly than in the vast production of great bombers, the greatest of which was the Boeing B-17. This formation is of B-17Gs from Ridgewell, England, 1944.***

UK

# Armstrong Whitworth Whitley



*A Whitley Mk V of No. 78 Sqn, RAF in early 1942, shortly before the squadron re-equipped with Halifaxes. The Whitley saw good service during the early years but was relegated to limited night operations by mid-war. It then passed on to coastal and glider-towing duties.*

It is unlikely that any other operational aeroplane of World War II came near to matching the austere, angular appearance of the **Armstrong Whitworth Whitley**, or to emulating its curious nose-down gait when flying 'straight and level'. Developed from the Armstrong Whitworth A.W.23 bomber/transport, the Whitley was designed to Specification B.3/34 and was first flown on 17 March 1936. That year it was selected to become the new Bomber Command's standard heavy bomber, replacing the Handley Page Heyford biplane. A total of 80 aircraft had been ordered, and these materialized as 34 **Whitley Mk I** bombers with two 682-kW (920-hp) Armstrong Siddeley Tiger IX radials, and 46 **Whitley Mk II** bombers with Tiger VIIIs. Early Whitley Mk Is possessed no dihedral on their outer wings. First squadron to receive Whitley Mk Is was No. 10 at Dishforth in March 1937.

The Whitley Mk I was already disappearing from front line service when war broke out (although the last examples did not leave No. 166 Squadron until April 1940). In the meantime the **Whitley Mk III** (also with Tiger VIIIs) had appeared; this version, of which 60 were produced, featured a retractable 'dustbin' ventral gun position. It served on Nos 7, 51, 58, 77, 97, 102 and 166 Squadrons, entering RAF service in August 1938. Also introduced that year was the **Whitley Mk IV** with 768-kW (1,030-hp) Rolls-Royce Merlin IV V-12 engines and the **Whitley Mk IVA** with 854-kW (1,145-hp) Merlin Xs; only 40 were produced, but they served to introduce a new power-operated four-gun Nash and Thompson tail turret (the 'dustbin' being abandoned).

The main production version was the **Whitley Mk V**, whose delivery started to Nos 77 and 78 Squadrons in September 1939, and of which 1,476 were built before June 1943, when production was halted. Also powered by Merlin Xs, the Whitley Mk V featured a 38-cm (15-in) longer fuselage and straight leading edges to the fins.

Although it was the Tiger-powered Mk III that performed almost all the early leaflet-dropping sorties of the first six months of the war (including the first sortie over Germany on the night of 3-4 September 1939 by 10 Whitleys of Nos 51 and 58 Squadrons), it was the Whitley Mk V that assumed the bombing role from March 1940 onwards; and on 11-12 May, immediately after the German attack in the West, Whitleys and Handley Page Hampdens dropped the first RAF bombs on the German mainland in an attack on railway targets near München Gladbach.

The following month Whitleys were the first RAF bombers to attack targets in Italy, flying from the UK and refuelling in the Channel Islands to attack Turin and Genoa. Though never to achieve fame for outstanding exploits, the immensely rugged Whitley gave yeoman service with Bomber Command despite being obviously slow and vulnerable in the face of fast improving enemy night defences. They were for instance among the aircraft that first raided Berlin on the night of 25-26 August 1940, and it was as the pilot of a Whitley during a raid on Cologne on 12-13 November that year that Leonard Cheshire (later Group Captain, VC) was awarded the DSO. Wing Commander P. C. Pickard (later to achieve fame as the Mosquito leader in the raid on Amiens gaol) led Whitleys of No. 51 Squadron in the airborne raid on the radar installation at Bruneval on 27-28 February 1942.

Whitleys flew their last raid with Bomber Command during an attack on Ostend on the night of 29-30 April 1942.

### Specification

**Armstrong Whitworth Whitley Mk V**

**Type:** five-man bomber

**Powerplant:** two 854-kW (1,145-hp) Rolls-Royce Merlin X V-12 piston engines

**Performance:** maximum speed 370 km/h (230 mph) at 5000 m (16,400 ft); climb to 4570 m (15,000 ft) in 16 minutes; service ceiling 7925 m (26,000 ft); range 2415 km (1,500 miles) with normal tankage

**Weights:** empty 8777 kg (19,350 lb); maximum take-off 15196 kg (33,500 lb)

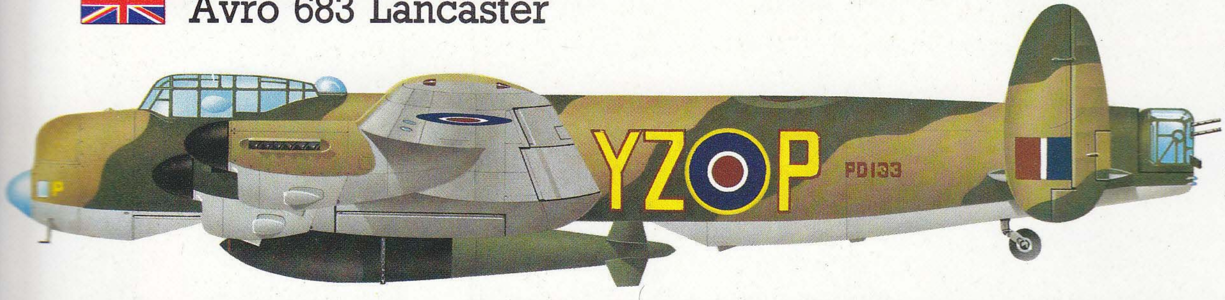
**Dimensions:** span 25.60 m (84 ft 0 in); length 21.11 m (69 ft 3 in); height 4.57 m (15 ft 0 in); wing area 105.63 m$^2$ (1,137.00 sq ft)

**Armament:** one 7.7-mm (0.303-in) machine-gun in the nose turret and four 7.7-mm (0.303-in) machine-guns in the tail turret, plus a maximum bombload of 3175 kg (7,000 lb)

*Ground crew prepare a Whitley Mk V for operations in 1940. The aircraft flew from Dishforth and sports typical camouflage for the period. The Whitley Mk V was the mainstay of Bomber Command along with the Wellington until the arrival of the Halifax and Lancaster.*

UK

# Avro 683 Lancaster



*By cutting away the underfuselage and removing nose and dorsal turrets to save weight, the Lancaster B.Mk 1s (Special) of No. 617 Sqn at Waddington were able to carry the 22,000-lb (9979-kg) 'Grand Slam', first used to great effect on the Bielefeld Viaduct.*

No one would dispute the statement that the **Avro Lancaster** was the finest British heavy bomber of World War II; indeed many would even argue that it was the finest heavy bomber serving on either side during the conflict, and it is therefore strange to recall that it had its genesis in the unsuccessful twin-engine Avro Manchester.

However, it is not entirely true to say that the Lancaster was virtually a four-engine Manchester, as four-engine installations in the basic airframe had been proposed before Manchester deliveries to the RAF began. But the prototype Lancaster was, in fact, a converted Manchester airframe with an enlarged wing outer panels and four 1,145-hp (854-kW) Rolls-Royce Merlin Xs. This prototype initially retained the Manchester's triple tail assembly, but was later modified to the twin fin and rudder assembly which became standard on production Lancasters.

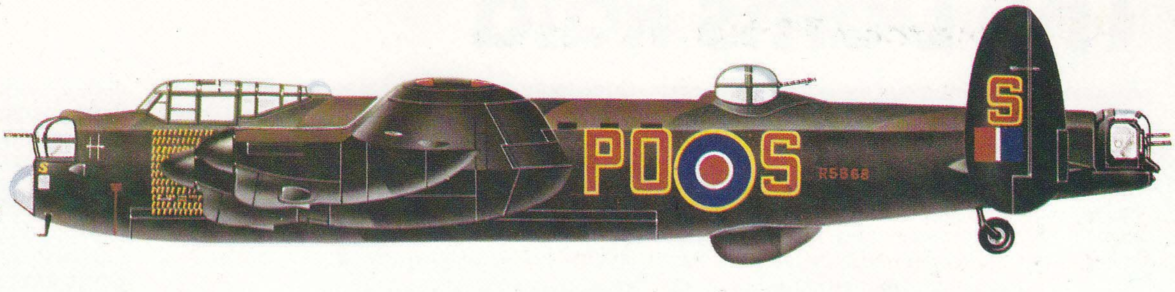
The prototype flew on 9 January 1941 and later that month went to the Aeroplane and Armament Experimental Establishment, Boscombe Down, to begin intensive flying trials.

The new bomber was an immediate success, and large production orders were placed. Such was the speed of development in wartime that the first production Lancaster was flown in October 1941, a number of partially completed Manchester airframes being converted on the line to emerge as **Lancaster Mk I** (from 1942 redesignated **Lancaster B.Mk I**) aircraft.

Lancasters soon began to replace Manchesters, and such was the impetus of production that a shortage of Merlin engines was threatened. This was countered by licence-production by Packard in the USA of the Merlin not only for Lancasters but for other types. An additional insurance was effected in another way, the use of 1,735-hp (1294-kW) Bristol Hercules VI or XVI radial engines.

Meanwhile, the Merlin Lancasters were going from strength to strength. The prototype's engines gave way to 1,280-hp (954-kW) Merlin XXs and 22s, or 1,620-hp (1208-kW) Merlin 24s in production aircraft. Early thoughts of fitting a ventral turret were sadly discarded, and the Lancaster B.Mk I had three Frazer-Nash hydraulically-operated turrets with eight 7.7-mm (0.303-in) Browning machine-guns: two each in the nose and mid-upper dorsal positions and four in the tail turret. The bomb-bay, designed original-

*Lancaster B.Mk I of No. 467 Sqn, Royal Australian Air Force, flying from Waddington. Now preserved at the RAF Museum, the aircraft flew 137 sorties and bore the inscription 'No enemy aircraft will fly over the Reich territory': Goering's inaccurate and ironic prophecy.*



ly to carry 1814 kg (4,000 lb) of bombs, was enlarged progressively to carry bigger and bigger bombs: up to 3629 and 5443 kg (8,000 and 12,000 lb) and eventually to Barnes Wallis' enormous 9979-kg (22,000-lb) 'Grand Slam', the heaviest bomb carried by any aircraft in World War II.

The Lancaster's existence was not revealed to the public until 17 August of that year, when 12 aircraft from Nos 44 and 97 Squadrons carried out an unescorted daylight raid on Augsburg. Flown at low level, the raid inflicted considerable damage on a factory producing U-boat diesel engines, but the cost was high, seven aircraft being lost. Squadron Leaders Nettleton and Sherwood each received the Victoria Cross, the latter posthumously, for leading the operation, which perhaps confirmed to the Air Staff that unescorted daylight raids by heavy bombers were not a practicable proposition.

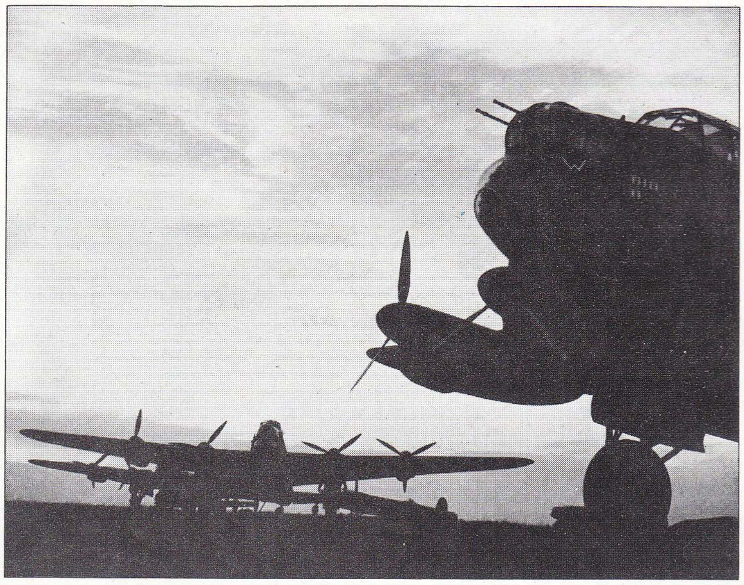
It would be true to say that development of the Lancaster went hand-in-hand with development of bombs. The early Lancasters carried their bomb loads in normal flush-fitting bomb bays, but as bombs got larger it became necessary, in order to be able to close the bomb doors, to make the bays deeper so that they protruded slightly below the fuselage line. Eventually, with other developments, the bomb doors were omitted altogether for certain specialist types of bomb.

The German battleship *Tirpitz* was attacked on several occasions by Lancasters until, on 12 November 1944, a combined force from Nos 9 and 617 Squadrons found the battleship in Tromso Fjord, Norway, and sank her with 5443-kg (12,000-lb) 'Tallboy' bombs, also designed by Barnes Wallis. The ultimate in conventional high explosive bombs was reached with the 9979-kg (22,000-lb) 'Grand Slam', a weapon designed to destroy concrete by exploding some way beneath the surface, so creating an earthquake effect. No. 617 Squadron first used the 'Grand Slam' operationally against the Bielefeld Viaduct on 14 March 1945, causing considerable destruction amongst its spans.

In spite of the other variants built from time to time, the Lancaster B.Mk I (**Lancaster B.Mk 1** from 1945) remained in production throughout the war, and the last was delivered by Armstrong Whitworth on 2 February 1946. Production had encompassed two Mk I prototypes, 3,425 Mk Is, 301 Mk IIs, 3,039 Mk IIIs, 180 Mk VIIs and 430 Mk Xs, a total of 7,377. These were built by Avro (3,673), Armstrong Whitworth (1,329), Austin Motors (330), Metropolitan Vickers (1,080), Vickers-Armstrongs (535) and Victory Aircraft (430). Some conversions between different mark numbers took place.

Statistics show that at least 59 Bomber Command squadrons operated Lancasters, which flew more than 156,000 sorties and dropped, in addition to 608,612 tons (618,350 tonnes) of high explosive bombs, more than 51 million incendiaries.

***Right: A summer evening in 1943: briefing is over, pre-flight checks completed, the aircraft bombed-up; soon the calm of the dispersal area will be shattered by the sound of Merlins. The nightly raids were inevitably met by fierce AA and night fighters, and the nearest aircraft's seven missions are no small feat.***



### Specification

**Avro Lancaster B.Mk I**

**Type:** seven-seat heavy bomber

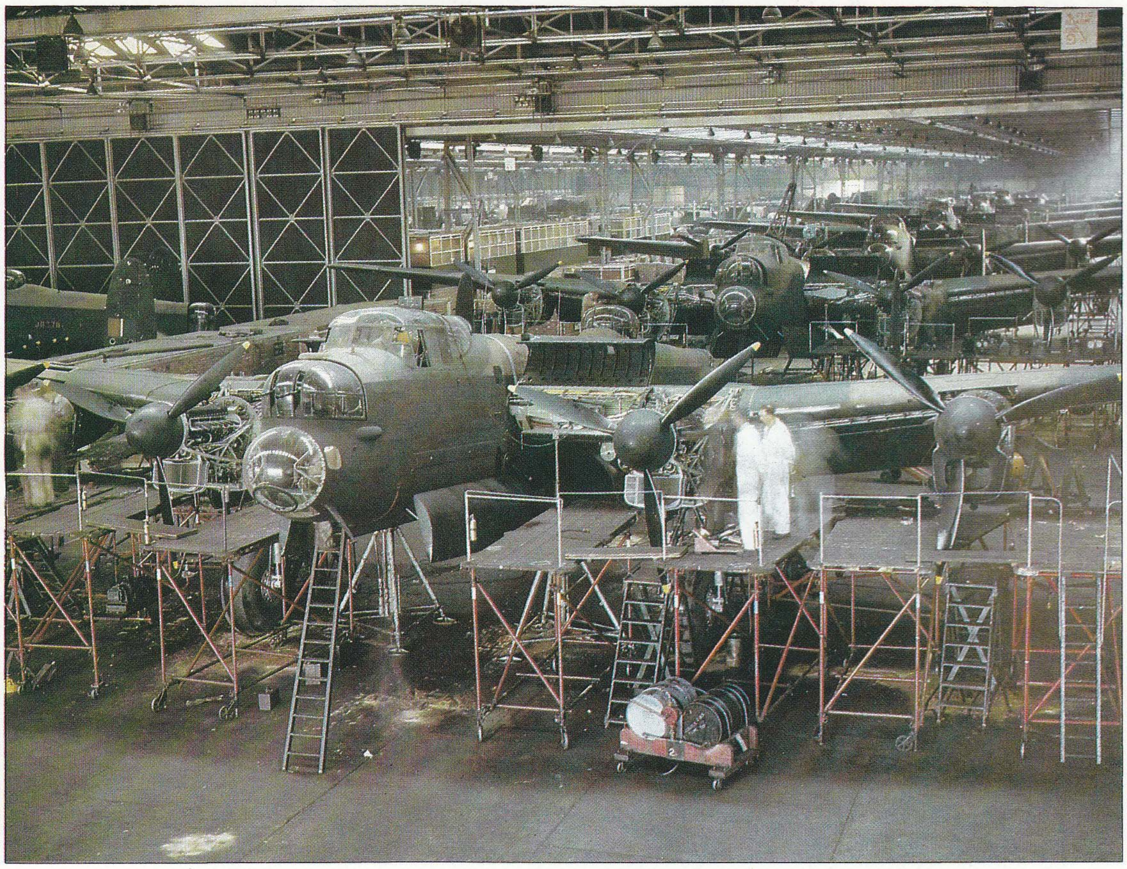
**Powerplant:** four 1223-kW (1,640-hp) Rolls-Royce Merlin XXIV V-12 piston engines

**Performance:** maximum speed 462 km/h (287 mph) at 3505 m (11,500 ft); cruising speed 338 km/h (210 mph) at 6096 m (20,000 ft); service ceiling 7470 m (24,500 ft); range 4070 km (2,530 miles) with 7,000-lb (3175-kg) bombload

**Weights:** empty 16738 kg (36,900 lb); maximum take-off 31751 kg (70,000 lb)

**Dimensions:** span 31.09 m (102 ft 0 in); length 21.18 m (69 ft 6 in); height 6.10 m (20 ft 0 in); wing area 120.49 m$^2$ (1,297.0 sq ft)

**Armament:** 7.7-mm (0.303-in) machine-guns (two each in nose and dorsal turrets, and four in tail turret), plus bomb load comprising one (9979-kg (22,000-lb) bomb or up to 6350 kg (14,000-lb) of smaller bombs.



*Lancaster Mk IIIs pour off the production line at A.V. Roe's Woodford factory. A total of 7,377 aircraft were built by a variety of manufacturers, and the sheer volume of this effort combined with the considerable qualities of the aircraft played a considerable part in the destruction of the Reich.*

# The Dams Raid

A fundamental attribute of the bomber weapon in World War II was its ability to strike key targets that, as a result of their remoteness deep inside enemy territory, were otherwise invulnerable to alternative means of attack – a function that has since been assumed by the long-range ballistic and stand-off missiles. One of the most spectacular and successful of these 'setpiece' operations was RAF Bomber Command's attack in May 1943 on the Ruhr dams, whose associated power stations served Germany's great industrial complex.

Central to this audacious adventure, codenamed Operation 'Chastise', were the development of a special demolition weapon and the selection and training of highly experienced bomber crews to carry out the attacks. For some months one of the UK's most accomplished aeronautical engineers, Barnes Wallis, had been advocating aerial attacks on these key targets and, having arrived at the conclusion that any conventional bomb capable of breaching the dams would be far too heavy (even for the Avro Lancaster), Wallis turned his attention to a less conventional weapon. He demonstrated that if a 2722-kg (6,000-lb) charge of RDX could be detonated against the underwater mass of the dam, the shock waves would be sufficient to weaken and eventually to collapse the structure. To do this Wallis designed a cylindrical mine which, pre-rotated (in reverse direction) immediately before low-level release at an exactly determined altitude and distance from the dam, would ricochet along the water surface before sinking against the dam wall and detonating by means of hydrostatic fuses.

## Hand-picked force

As tests with half-size weapons dropped by a Vickers Wellington were performed to demonstrate their feasibility, Sir Arthur Harris, commander-in-chief of Bomber Command, was instructed on 17 March 1943 by the Air Staff to create a special squadron to attack the dams, identified by an Air Ministry committee as the Möhne, Eder, Sorpe, Lister, Schwelme and Ennepe dams. The principal Main Force group with Lancasters at that time was No. 5 Group, and its commander, Sir Ralph Cochrane, selected Wing Commander Guy Penrose Gibson DSO DFC (then commander of No. 106 Squadron) to head the new unit, soon to be designated No. 617 Squadron. Only four days later the squadron officially came into being as the hand-picked crews began assembling at Scampton, Lincs. Gibson, himself a veteran of three tours of operations, was allowed to select the Lancaster crews and, without yet being informed of the ultimate target, set about instructing them in the daunting task of releasing a bomb at a height of exactly 18.3 m (60 ft) above water at night, at a speed of 402 km/h (250 mph) and at a distance of between 366 and 411 m (400 and 450 yards) from a target.

## Secrecy to the last

The date for the attack, namely 16 May, had been decided to produce a coincidence of maximum moonlight with the highest seasonal water level at the dams, and it was only on the previous day that Gibson was permitted to brief his crews on the actual target. By then 20 specially modified Lancaster B.Mk IIIs had been delivered to Scampton; bomb doors had been removed and a pair of V-crutches added below the aircraft centre of gravity, between which was suspended the 127-cm (50-in) diameter, 4196-kg (9,250-lb) weapon (codenamed 'Upkeep'); dorsal turrets, considered superfluous on this operation, were also deleted. The weapon-release height, whose precision was vital to avoid premature disintegration on impact with the water, was to be achieved by the use of two spotlights under the nose and tail of the Lancaster whose beams converged to form a figure '8' on the surface of the water at exactly 18.3 m (60 ft).

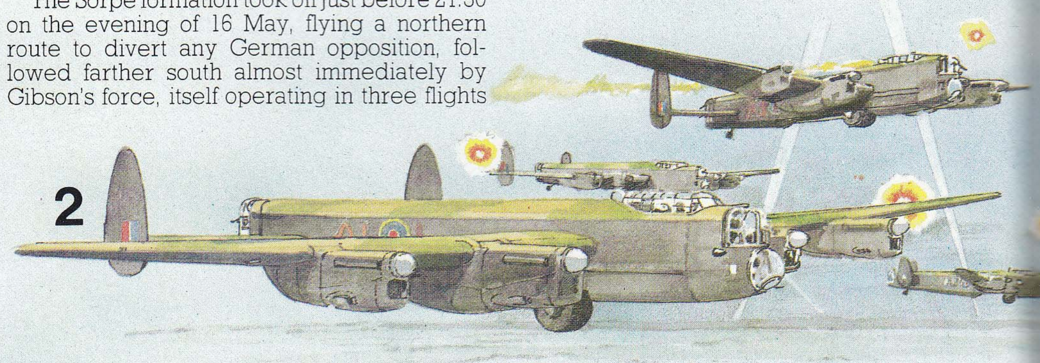
In the event 19 of the 21 crews took off for the attacks. Gibson divided his force into three wave formations, himself leading nine aircraft against the Möhne dam. A second group of five Lancasters, led by Flight Lieutenant Joseph C. McCarthy DFC (an American serving with the RAF) was to attack the Sorpe dam. The remaining five Lancasters, headed by Flight Lieutenant W. C. Townsend CGM, DFM, were to operate as a 'mobile reserve'.

The Sorpe formation took off just before 21.30 on the evening of 16 May, flying a northern route to divert any German opposition, followed farther south almost immediately by Gibson's force, itself operating in three flights of three aircraft, separated by 10 minutes, the flights being led by Gibson, Squadron Leader Henry Maudslay DFC and Squadron Leader 'Dinghy' Young DFC. The reserve group took off at around midnight.

The Lancasters flew out over the Norfolk coast and dropped to a height of about 30 m (100 ft) to avoid detection by enemy radar, the Sorpe formation crossing the Dutch coast near Vlieland and Gibson's formation some 80 km (50 miles) to the south. Flak over the Netherlands decimated the former, striking the Lancaster flown by the New Zealander, Flight Lieutenant J. L. Munro DSO DFC, destroying its radio and intercom, and forcing the pilot to abandon his attack and return home. The aircraft flown by Flying Officer G. Rice struck the waters of the Zuider Zee and, despite a miraculous recovery, had its mine torn off, also forcing the pilot to turn back. Two other aircraft in the Sorpe formation, flown by Flight Lieutenant Barlow (an Australian) and Sergeant Byers, were shot down by Flak, their crews all being killed. Only McCarthy himself, who was flying some 97 km (60 miles) behind his formation, having been delayed on take-off by an unserviceable aircraft, survived in the Sorpe group.

## The final run-in

Meanwhile Gibson was leading his section of three aircraft at as little as 12 m (40 ft) above the Dutch countryside as their bomb aimers called warnings of houses, trees and other obstructions looming ahead. Near Rosendaal the Lancaster flown by Flight Lieutenant Bill Astell DFC was hit by Flak and crashed. Skirting the main Ruhr defences, Gibson led his aircraft to the north of Hamm before setting final course for the Möhne, easily sighting his massive target in the moonlight. As the dam's gun defences quickly came into action, Gibson flew a



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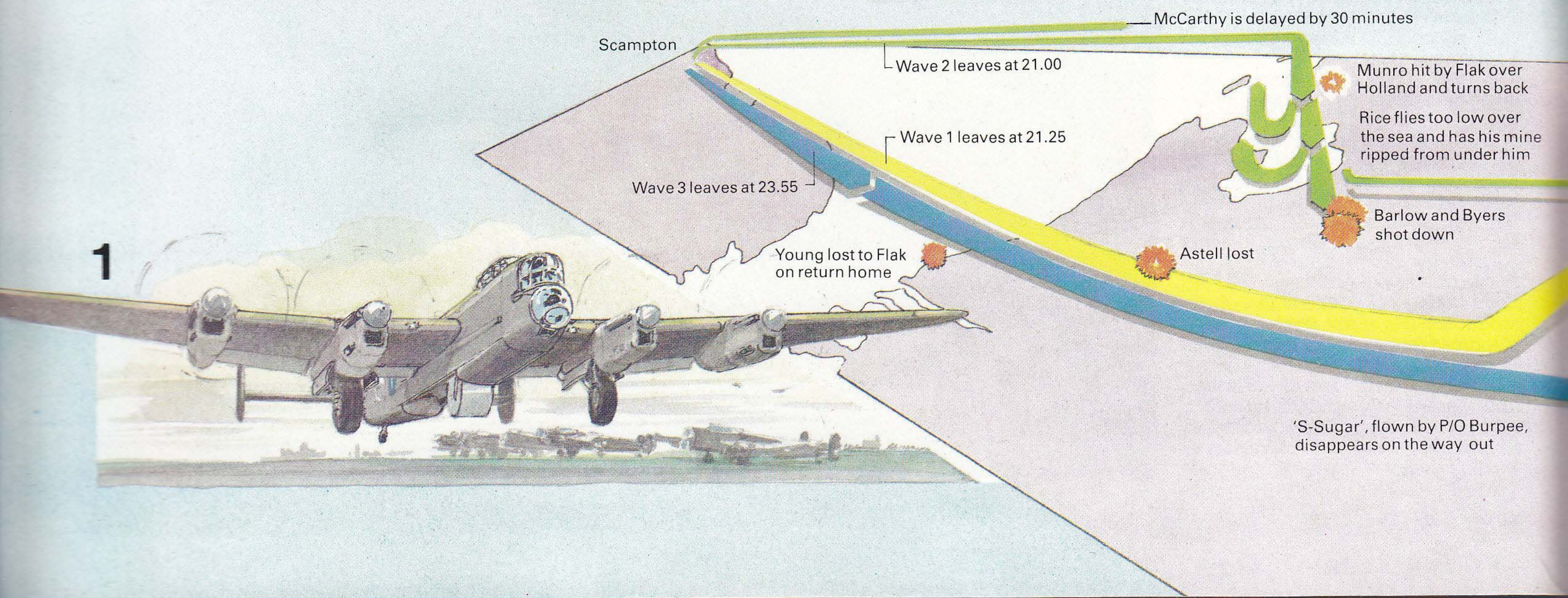

Scampton
McCarthy is delayed by 30 minutes
Wave 2 leaves at 21.00
Munro hit by Flak over Holland and turns back
Rice flies too low over the sea and has his mine ripped from under him
Wave 1 leaves at 21.25
Wave 3 leaves at 23.55
Barlow and Byers shot down
Young lost to Flak on return home
Astell lost
'S-Sugar', flown by P/O Burpee, disappears on the way out

1

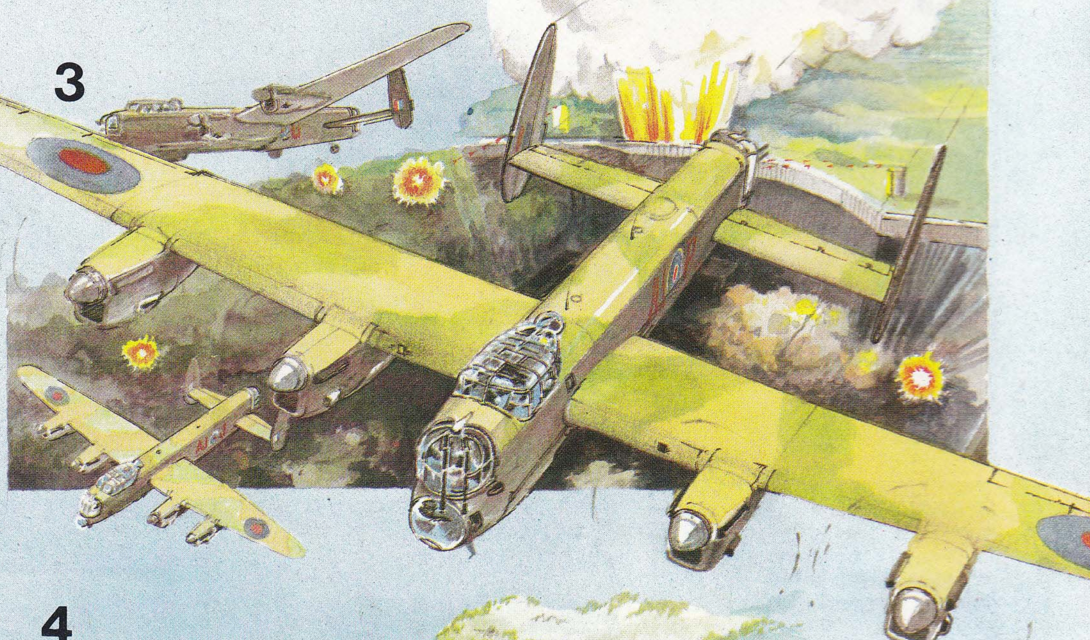
perfect attack, his mine detonating in the exact centre of the dam. Pulling up to circle the target, Gibson saw Flight Lieutenant J. V. Hopgood's Lancaster hit by Flak as it approached the dam, its mine overshooting the parapet and striking the power station beyond; however, with fire raging in the stricken aircraft, its fuel tanks exploded and destroyed the Lancaster and its crew. As the next aircraft, flown by Squadron Leader H. B. Martin (later DSO and Bar, DFC and two Bars, AFC) made its attack, Gibson flew over the dam to draw off the Flak. Martin's mine also dropped accurately and detonated against the dam, but still it remained intact. Next came 'Dinghy' Young, accompanied by Gibson and Martin to distract the enemy gunners, his mine erupting on the target. It was the next attack, by Flight Lieutenant D. J. H. Maltby DFC, that caused the great concrete structure to collapse, the circling pilots watching in awe as a huge breach, 91 m (100 yards) across, opened and the pent-up mass of 134 million tons of water burst forth into the valley below.

Ordering Martin and Maltby to return home, Gibson called up Young (as his deputy controller in case he was shot down), Maudslay, Flight Lieutenant D. J. Shannon (later DSO and Bar, DFC and Bar) and Pilot Officer L. G. Knight DSO, to set course with him to the Eder. Located in a deeper valley than the Möhne, the Eder dam proved a far more difficult target to attack, Shannon making six abortive runs before successfully delivering his mine on target. Maudslay's mine struck the parapet and blew up on impact, destroying the Lancaster. It was the last remaining mine, dropped by Knight, that finally breached the Eder, causing an even greater spectacle than at the Möhne as 200 million tons of water burst down the narrow valley.

Farther afield, McCarthy made his way alone to the Sorpe, where he dropped his mine accurately but only succeeded in crumbling a stretch of the dam's parapet. Gibson ordered three of the reserve aircraft to back up this attack, but only one managed to do so and the dam survived without being breached. The last two reserve Lancasters were ordered to make for the Lister and Schwelme dams; the latter was evidently attacked but without success, and the aircraft detailed for the Lister was apparently shot down, for its crew failed to return.

The breaching of the Möhne and Eder dams was unquestionably an astonishing feat of arms, superbly conceived and planned, and brilliantly executed by 133 young men, of whom 56, in eight Lancasters, did not come back. The attack served, more than any other, to demonstrate the skill and courage that now existed within RAF Bomber Command as its assault on Germany gained momentum. Its leader, Guy Gibson (awarded the Victoria Cross for his unsurpassed bravery and determined leadership) became synonymous with the generation of young men who, night after night, braved enemy Flak and fighters to take the war to the German homeland. Though he himself was to lose his life over enemy territory a year later, his squadron – proud bearer of the soubriquet 'Dambusters' – survived as an élite unit, charged with the mounting of particularly hazardous attacks and with the destruction of a long list of vital targets.

**3**



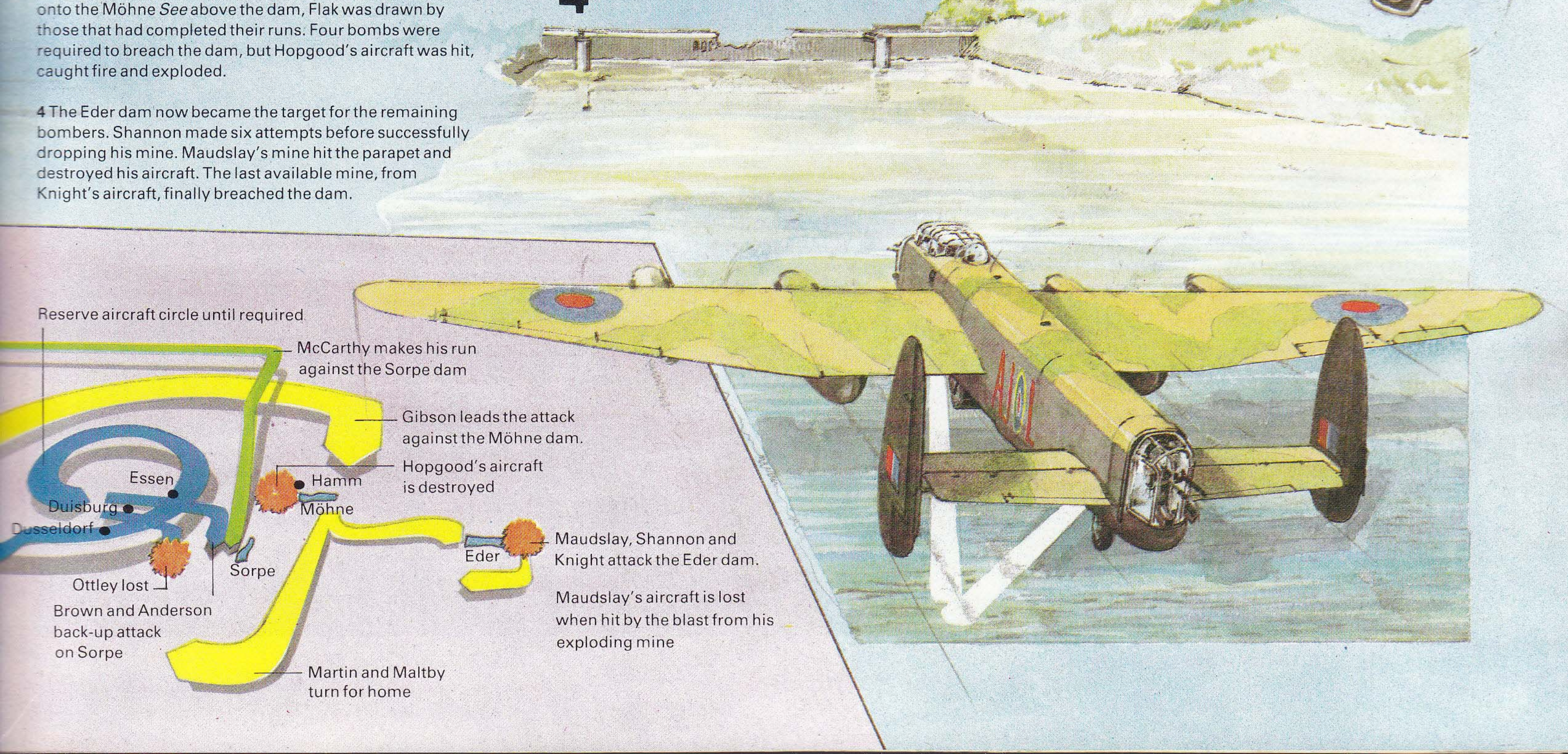
**1** Gibson divided his force of 19 aircraft into three wave formations. Wave 2 were to attack the Sorpe dam and left ahead of the others. The main force of nine aircraft (wave 1) under Gibson set off for the Möhne dam 15 minutes later. The remaining five reserve aircraft (wave 3) followed 2½ hours behind.

**2** Wave 2, taking the northern route, ran into heavy Flak over the Dutch coast. Two aircraft were shot down, one turned homeward with severe damage and a fourth flew so low that the mine was torn from its belly.

**3** As each member of the main force dropped their bombs onto the Möhne *See* above the dam, Flak was drawn by those that had completed their runs. Four bombs were required to breach the dam, but Hopgood's aircraft was hit, caught fire and exploded.

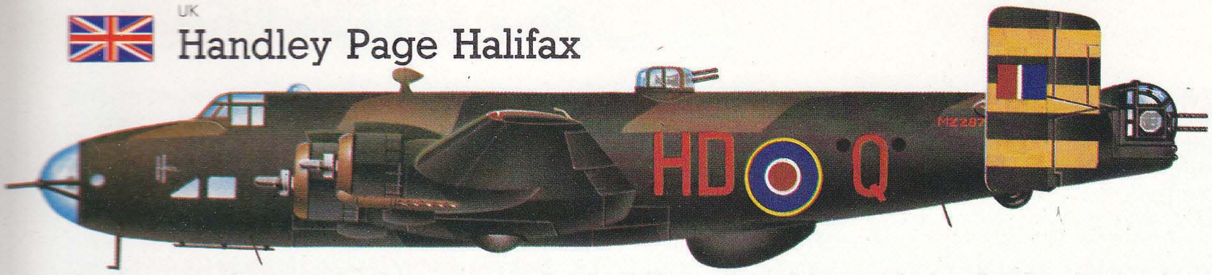
**4** The Eder dam now became the target for the remaining bombers. Shannon made six attempts before successfully dropping his mine. Maudslay's mine hit the parapet and destroyed his aircraft. The last available mine, from Knight's aircraft, finally breached the dam.

**4**


Reserve aircraft circle until required
McCarthy makes his run against the Sorpe dam
Gibson leads the attack against the Möhne dam.
Hopgood's aircraft is destroyed
Essen
Hamm
Duisburg
Möhne
Dusseldorf
Eder
Maudslay, Shannon and Knight attack the Eder dam.
Maudslay's aircraft is lost when hit by the blast from his exploding mine
Sorpe
Ottley lost
Brown and Anderson back-up attack on Sorpe
Martin and Maltby turn for home

UK

# Handley Page Halifax



*Sporting the distinctive tail markings adopted by squadrons of Bomber Command's No. 4 Group, this Halifax Mk III of No. 466 Sqn, RAAF, was based at Leconfield in the mid-war years. The aircraft features the large $H_2S$ radome under the rear fuselage.*

Second only in importance to the Avro Lancaster in Bomber Command's great night offensive between 1941 and 1945, the four-engine **Handley Page Halifax** was originally designed around a pair of Vulture engines but, when first flown on 25 October 1939, the choice of four Merlins had been made. The first aircraft arrived in No. 35 Squadron in November 1940 and flew their first raid on 10-11 March 1941. Production was widely subcontracted and quickly accelerated, the Merlin X-powered **Halifax Mk I** with two-gun nose turret and no dorsal turret being followed by the **Halifax Mk IIA Series 1** with Merlin XXs and a two-gun dorsal turret. In the **Halifax Mk II Series 1A** a large transparent fairing improved the whole nose shape, this version also introducing a Defiant-type four-gun dorsal turret. The **Halifax Mk III** was powered by Bristol Hercules XVI radials, and later examples introduced a wing span increased from 30.12 m (98 ft 10 in) to 31.75 m (104 ft 2 in). The **Halifax Mk V** with Dowty landing gear served with Coastal and Bomber Commands; the **Halifax Mk VI** with Hercules 100 engines and **Halifax Mk VII** with Hercules XVIs (both versions with increased fuel capacity) joined Bomber Command in 1944. Halifax Mks III, V and VII versions also served in paratrooping and glider towing roles with the airborne forces (being the only aircraft to tow the big Hamilcar) and were joined by the **Halifax Mk VIII** just before the end of the war. Production totalled 6,176 Halifaxes, the bomber versions flying a total of 75,532 sorties and dropping 227,610 tons of bombs.

## Specification

**Handley Page Halifax Mk VI**

**Type:** seven-crew night heavy bomber

**Powerplant:** four 1,800-hp (1343-kW) Bristol Hercules 100 radial piston engines

**Performance:** maximum speed 502 km/h (312 mph) at 6705 m (22,000 ft); climb to 6096 m (20,000 ft) in 50 minutes; service ceiling 7315 m (24,000 ft); range with 5897-kg (13,000-lb) bombload 2028 km (1,260 miles)

**Weights:** empty 17690 kg (39,000 lb); maximum take-off 30845 kg (68,000 lb)

**Dimensions:** span 31.75 m (104 ft 2 in); length 21.82 m (71 ft 7 in); height 6.32 m (20 ft 9 in); wing area 118.45 m$^2$ (1,275.0 sq ft)

**Armament:** one 7.7-mm (0.303-in) machine-gun in nose and four 7.7-mm (0.303-in) machine-guns in each of dorsal and tail turrets, plus a maximum bombload of 5897 kg (13,000 lb)

*Two Merlin-powered Halifax Mk II Series 1 of No. 35 (Madras Presidency) Sqn, the first unit equipped with the type, are seen on air test during the winter of 1941. The dorsal turret created much drag and some later models had this removed.*

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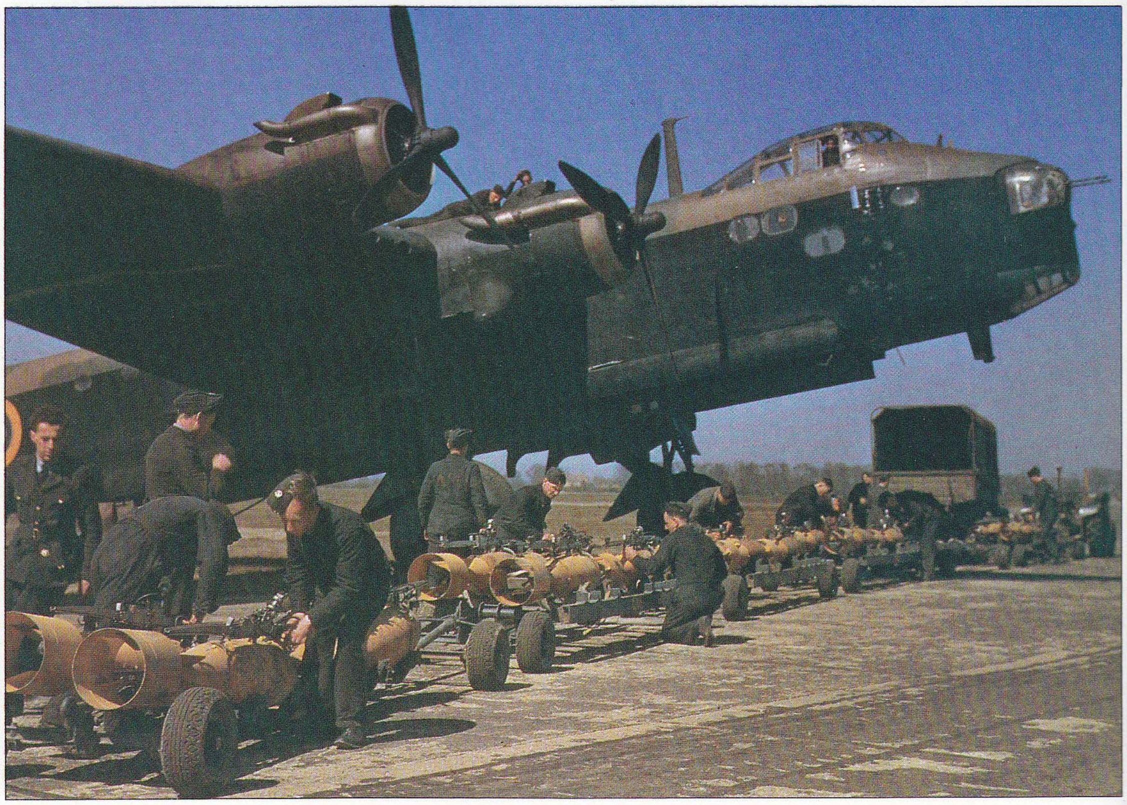
UK

# Short Stirling

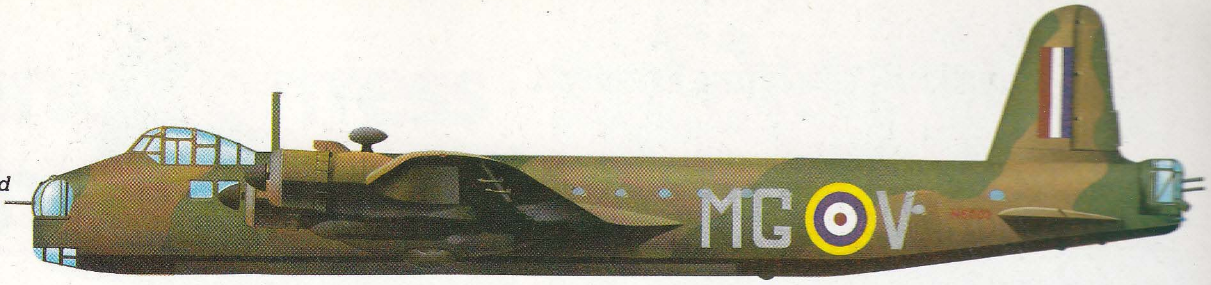
The **Short Stirling** was the first of RAF Bomber Command's trio of four-engine heavy bombers that mounted the great night offensive over Europe during the last four years of the war, and the only one conceived from the outset as a four-engine aircraft. Designed to a 1936 specification, the Stirling was initially flown as a half-scale prototype in 1938, this being followed by the full-size prototype which was destroyed on its first flight in May 1939. Production deliveries were first made to No. 7 Squadron in August 1940 (at the height of the Battle of Britain) and the **Stirling Mk I** flew its first operation on 10-11 February 1941. The type first bombed Berlin two months later. The Stirling Mk I of which 756 were produced, was powered by Hercules XI radials, but the **Stirling Mk II** with Wright Cyclones did not progress beyond the prototype stage. The **Stirling Mk III** was powered by Hercules XVIs and, with 875 built (plus many Mk Is converted) consti-



*The Stirling was hampered throughout its bombing career by an inability to reach the optimum operating altitude of 6100 m (20,000 ft), due to too short a wingspan, and a bomb bay which could not be adapted to carry the ever-larger bombs being produced.*

## Short Stirling (continued)

*Stirling Mk I Series 1 bombers were delivered in January 1941 with no dorsal turret. These early deliveries were camouflaged in dark green and dark earth down the fuselage sides and were assigned to escorted daylight missions, in this instance with No. 7 Sqn.*



tuted the main bomber variant; it also introduced the two-gun dorsal turret. Stirlings were the first operational aircraft to carry the original form of 'Oboe' navaid in 1941, and in August 1942 took part in the first Pathfinder operations. Two posthumous VCs were won by Stirling pilots (Flight Sergeant R. H. Middleton of No. 149 Squadron and Flight Sergeant A. L. Aaron of No. 218 Squadron), both during raids on northern Italy. By 1944 the Stirling Mk III was obsolescent, and flew its last raid in September that year. The **Stirling Mk IV** (of which 577 were built) was a transport/glider tug without nose and dorsal turrets, and was widely used on operations by the airborne forces during the last year of the war. The **Stirling Mk V** transport (160 built), without armament, joined the RAF in January 1945. Stirling bombers equipped 15 squadrons.

### Specification

**Short Stirling Mk III**

**Type:** seven- or eight-crew night heavy bomber

**Powerplant:** four 1,650-hp (1231-kW) Bristol Hercules XVI radial piston engines

**Performance:** maximum speed 435 km/h (270 mph) at 4420 m (14,500 ft); service ceiling 5180 m (17,000 ft); range with 6350-kg (14,000-lb) bombload 949 km (590 miles)

**Weights:** empty 19596 kg (43,200 lb); maximum take-off 31790 kg (70,000 lb)

**Dimensions:** span 30.20 m (99 ft 1 in); length 26.50 m (87 ft 3 in); height 6.93 m (22 ft 9 in); wing area 135.60 $m^2$ (1,460.0 sq ft)

**Armament:** two 7.7-mm (0.303-in) machine-guns in each of nose and dorsal turrets, and four 7.7-mm (0.303-in) guns in tail turret, plus a maximum bombload of 6350 kg (14,000 lb)

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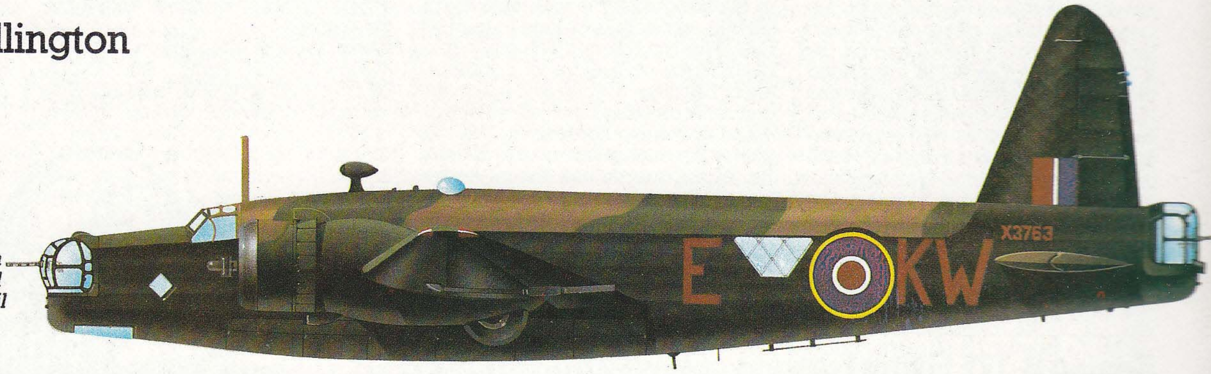
UK

# Vickers Wellington

*No. 425 (Alouette) Sqn, RCAF flew Wellington Mk IIIs from Dishforth, and this aircraft was lost in a raid on Stuttgart. Bomber Command's Wellingtons flew their last mission in October 1943, but the type soldiered on in coastal and transport units until the war's end.*



Employing the efficient geodetic lattice structure, the twin-engine **Vickers Wellington** continued in service with Bomber Command until 1943, far longer than its contemporaries, the Handley Page Hampden and Armstrong Whitworth Whitley. Designed to meet a 1932 requirement, the Wellington first flew on 15 June 1936 and in its **Wellington Mk I** form with Pegasus radials joined the RAF (No. 9 Squadron) in October 1938. The **Wellington Mk IA** (with Nash and Thompson nose and tail gun turrets) and the **Wellington Mk IC** (with lateral guns in place of the ventral turret) followed, together with the Merlin-powered **Wellington Mk II** and Hercules III- or XI-powered **Wellington Mk III**, and at the begining of the war six squadrons were flying the Wellington. Early daylight raids resulted in heavy losses owing to the Wellington's large defenceless arcs and in 1940 the aircraft joined the night bombing force. On 1 April 1941 a Wellington dropped the RAF's first 1814-kg (4,000-lb) bomb. Subsequent bomber versions included the Twin Wasp-powered **Wellington Mk IV**, and **Wellington Mk V** and **Mk VI** high-altitude aircraft with pressure cabins and Hercules or Merlin engines respectively; these latter versions did not see combat service. The **Wellington Mk X** with Hercules XVIIIs was the final bomber version, and the last raid by Bomber Command Wellingtons took place on 8-9 October 1943. In the meantime Wellingtons had been flying on maritime duties, the **Wellington DW. Mk I** with large mine-exploding hoops having operated in 1940 and Wellington Mk IC minelayers soon after this. Coastal Command versions included the **Wellington GR.Mk VIII** with Pegasus engines and ASV radar, the **Wellington GR.Mks XI, XII** and **XIV** with Hercules, Leigh Light and provision for two torpedoes; the **Wellington T. Mks XVII** and **XVIII** were trainers, and many Mk Xs were converted to 'flying classrooms'. Wellingtons were also used as test-beds for early jet engines. The **Wellington C.Mks XV** and **XVI** were transport conversions of the Mk IC. A total of 11,461 aircraft was produced.

### Specification

**Vickers Wellington Mk III**

**Type:** six-crew night medium bomber

**Powerplant:** two 1119-kW (1,500-hp) Bristol Hercules XI radial piston engines

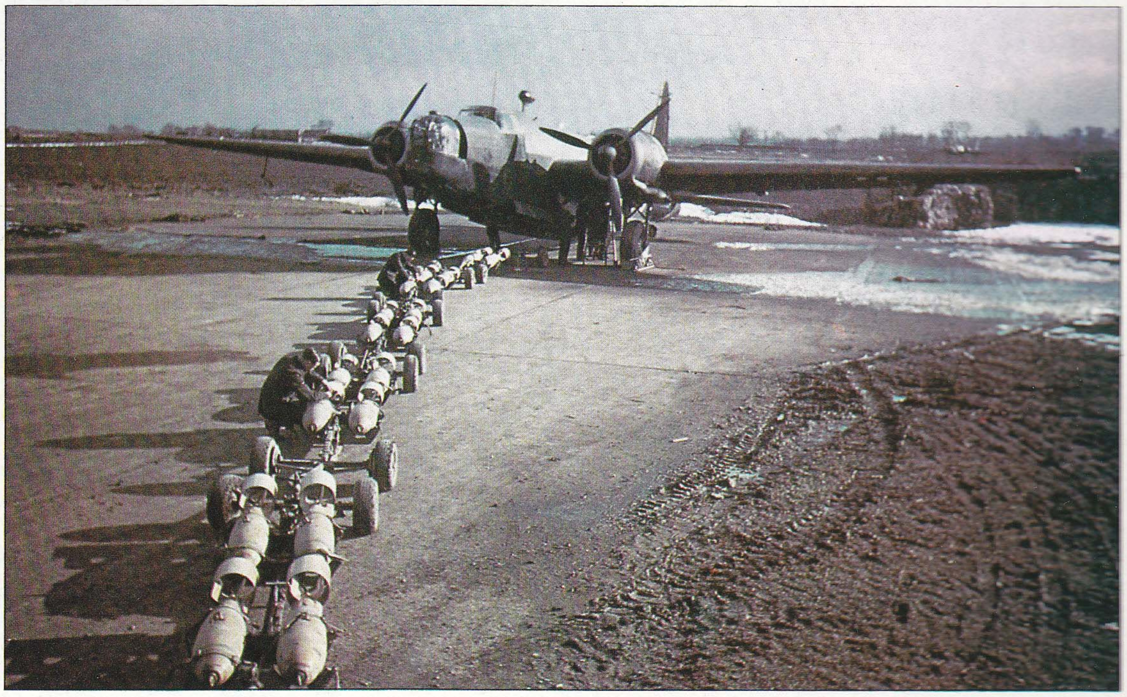
**Performance:** maximum speed 411 km/h (255 mph) at 3810 m (12,500 ft); initial climb 283 m (930 ft) per minute; service ceiling 5790 m (19,000 ft); range with 2041-kg (4,500-lb) bombload 2478 km (1,540 miles)

**Weights:** empty 8605 kg (18,970 lb); maximum take-off 15422 kg (34,000 lb)

**Dimensions:** span 26.26 m (86 ft 2 in); length 19.68 m (64 ft 7 in); height 5 m (17 ft 5 in); wing area 78.04 $m^2$ (840.0 sq ft)

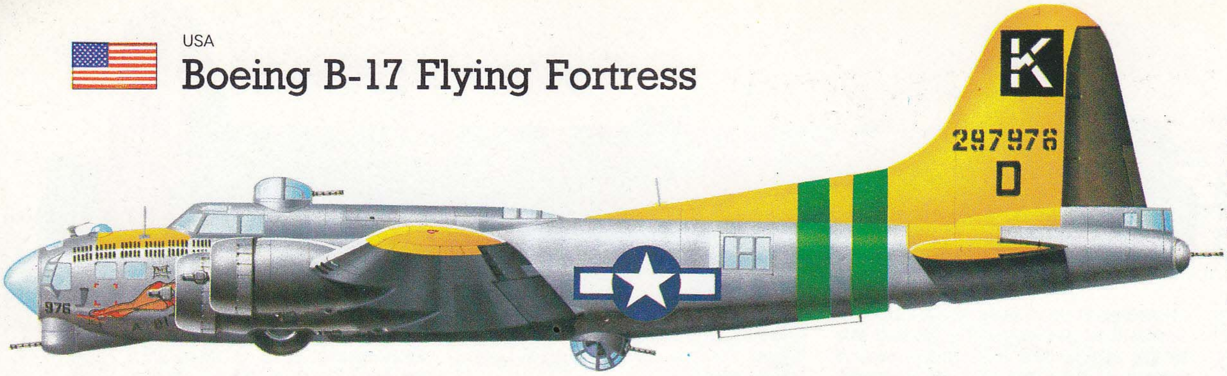
**Armament:** two 7.7-mm (0.303-in) machine-guns in nose turret, four 7.7-mm (0.303-in) guns in tail turret, and two 7.7-mm (0.303-in) machine-guns in beam positions, plus a maximum bombload of 2041 kg (4,500 lb)

*Armourers prepare the fuses of 500-lb (227-kg) bombs before moving the bomb train under the fuselage of a Wellington. The aircraft had a poor start on day missions, proving easy meat for German fighters, but found itself admirably suited for night ops, setting the trend for RAF bombing throughout the war.*



USA

# Boeing B-17 Flying Fortress



*This Boeing B-17G, A Bit o'Lace of the 711th BS, 447th BG was based at Rattlesden. Spectacular nose art became a speciality of the US Army Air Force, and art featuring the female form was invariably well executed. This contrasted with a virtual ban on nose art by RAF Bomber Command.*

Pursuing an operational theory that high flying, heavily armed bombers were the surest means of striking strategic targets in daylight, the US Army Air Corps issued a requirement in 1934 for which the **Boeing Model 299 Flying Fortress** was designed and first flown on 28 July 1935. Twelve **Y1B-17** (later **B-17**) service test aircraft entered service in 1937 and were followed by small numbers of **B-17B** and **B-17C** bombers in 1940-1, and by the **B-17D** in 1941. The **B-17E** introduced the enlarged vertical tail surfaces and tail gun position characteristic of all subsequent B-17s, as well as power-operated twin-gun turrets aft of the cockpit and below the centre fuselage. 512 B-17Es were produced, this version being the first US Army Air Force heavy bomber to see combat in Europe with the 8th Air Force. A total of 3,400 **B-17F** bombers, with enlarged one-piece nose transparency, was produced during 1942-3, and these were followed by the principal variant, the **B-17G**, which, in reply to calls for improved nose armament to counter the Luftwaffe's head-on attacks, introduced the two-gun 'chin' turret; production totalled 8,680 B-17G aircraft by Boeing, Douglas and Lockheed-Vega. The Fortress was deployed principally in Europe during the war, with much smaller numbers operating in the Far East. The type carried out many epic raids, large formations of bombers, each bristling with heavy machine-guns and providing mutual protection against enemy fighters, pounding across the daylight skies over Hitler's Reich. In due course heavy losses forced the Americans to introduce escort fighters – the P-38, P-47 and P-51. One temporary expedient involved the use of a small number of B-17s modified as **YB-40** 'escort' aircraft, some aircraft carrying up to 30 machine-guns. Fortresses (B-17Cs, Fs and Gs) served in small numbers with RAF Bomber and Coastal Commands.

## Specification

**Boeing B-17G Flying Fortress**

**Type:** 10-crew daylight medium/heavy bomber

**Powerplant:** four 895-kW (1,200-hp) Wright Cyclone R-1820-97 radial piston engines

**Performance:** maximum speed 462 km/h (287 mph) at 7620 m (25,000 ft); climb to 6096 m (20,000 ft) in 37 minutes; service ceiling 10850 m (35,600 ft); range with 2722-kg (6,000-lb) bombload 3220 km (2,000 miles)

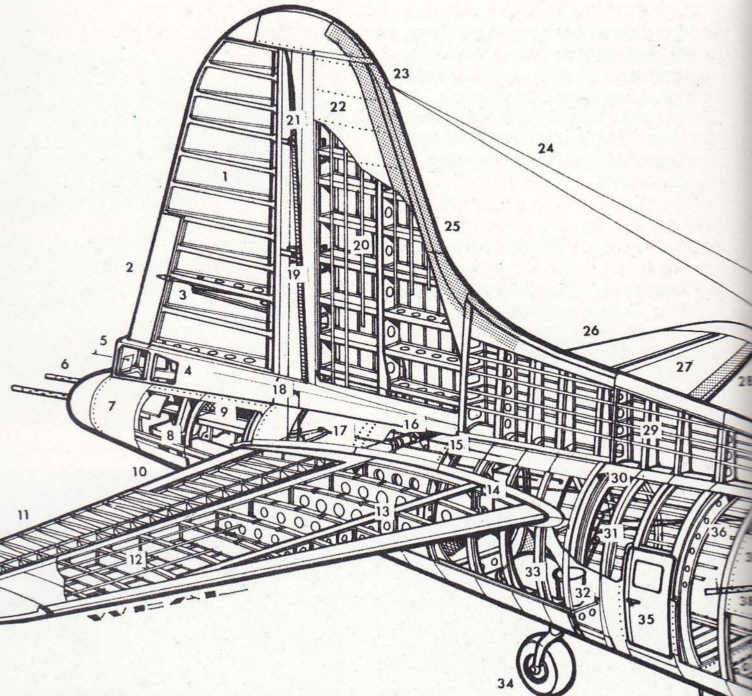
**Weights:** empty 16391 kg (36,135 lb); maximum take-off 32660 kg (72,000 lb)

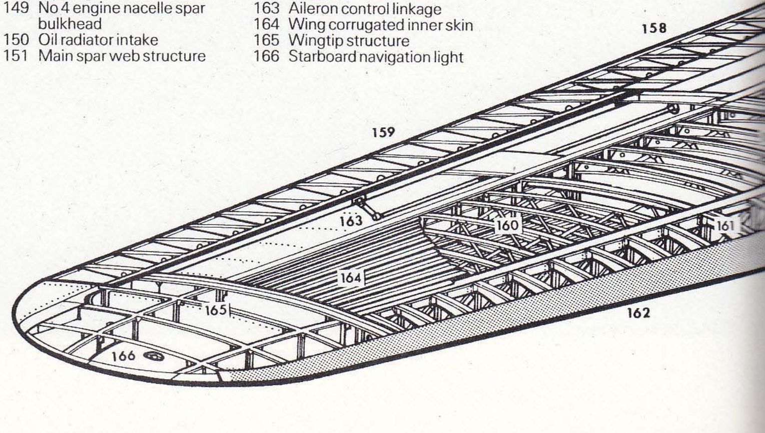
**Dimensions:** span 31.62 m (103 ft 9 in); length 22.78 m (74 ft 9 in); height 5.82 m (19 ft 1 in); wing area 131.92 m$^2$ (1,420.0 sq ft)

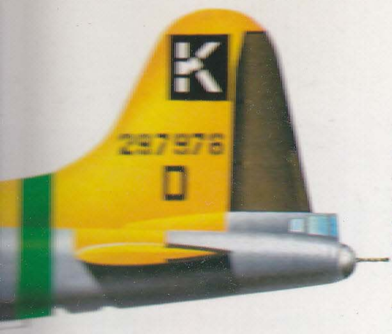
**Armament:** twin 12.7-mm (0.5-in) gun turrets under nose, aft of cockpit, under centre fuselage and in tail, and single-gun mountings in sides of nose, in radio operator's hatch and in waist (beam) positions, plus a maximum bombload of 7983 kg (17,600 lb)

## Boeing B-17F Flying Fortress cutaway drawing key

1 Rudder construction
2 Rudder tab
3 Rudder tab actuation
4 Tail gunner's station
5 Gunsight
6 Twin 0.5-in (12.7-mm machine guns)
7 Tail cone
8 Tail gunner's seat
9 Ammunition troughs
10 Elevator trim tab
11 Starboard elevator
12 Tailplane structure
13 Tailplane front spar
14 Tailplane/fuselage attachment
15 Control cables
16 Elevator control mechanism
17 Rudder control linkage
18 Rudder post
19 Rudder centre hinge
20 Fin structure
21 Rudder upper hinge
22 Fin skinning
23 Aerial attachment
24 Aerials
25 Fin leading-edge de-icing boot
26 Port elevator
27 Port tailplane
28 Tailplane leading-edge de-icing boot
29 Dorsal fin structure
30 Fuselage frame
31 Tailwheel actuation
32 Toilet
33 Tailwheel (retracted) fairing
34 Fully-swivelling retractable tailwheel
35 Crew entry door
36 Control cables
37 Starboard waist hatch
38 Starboard waist 0.5-in (12.7-mm) machine gun
39 Gun support frame
40 Ammunition box
41 Ventral aerial
42 Waist gunners' positions
43 Port waist 0.5-in (12.7-mm) machine gun
44 Ceiling control cable runs
45 Dorsal aerial mast
46 Ball turret stanchion support
47 Ball turret stanchion
48 Ball turret actuation mechanism
49 Support frame
50 Ball turret roof
51 Twin 0-5-in (12.7-mm) machine guns
52 Ventral ball turret
53 Wingroot fillet
54 Bulkhead
55 Radio operator's compartment
56 Camera access hatch
57 Radio compartment windows (port and starboard)
58 Ammunition boxes
59 Single 0.5-in (12.7-mm) dorsal machine gun
60 Radio compartment roof glazing
61 Radio compartment/bomb-bay bulkhead
62 Fire extinguisher
63 Radio operator's station (port side)
64 Handrail links
65 Bulkhead step
66 Wing rear spar/fuselage attachment
67 Wingroot profile
68 Bomb-bay central catwalk
69 Vertical bomb stowage racks (starboard installation shown)
70 Horizontal bomb stowage (port side shown)
71 Dinghy stowage
72 Twin 0.5-in (12.7-mm) machine guns
73 Dorsal turret
74 Port wing flaps
75 Cooling air slots
76 Aileron tab (port only)
77 Port aileron
78 Port navigation light
79 Wing skinning
80 Wing leading-edge de-icing boot
81 Port landing light
82 Wing corrugated inner skin
83 Port out wing fuel tank (nine inter-rib cells)
84 No 1 engine nacelle
85 Cooling gills
86 Three-blade propellers
87 No 2 engine nacelle
88 Wing leading-edge de-icing boot
89 Port mid-wing (self-sealing) fuel tanks
90 Flight deck upper glazing
91 Flight deck/bomb-bay bulkhead
92 Oxygen cylinders
93 Co-pilot's seat
94 Co-pilot's control column
95 Headrest/armour
96 Compass installation
97 Pilot's seat
98 Windscreen
99 Central control console pedestal
100 Side windows
101 Navigation equipment
102 Navigator's compartment upper window (subsequently replaced by ceiling astrodome)
103 Navigator's table
104 Side gun mounting
105 Enlarged cheek windows (flush)
106 Ammunition box
107 Bombardier's panel
108 Norden bombsight installation
109 Plexiglas frameless nose-cone
110 Single 0.5-in (12.7-mm) nose machine gun
111 Optically-flat bomb-aiming panel
112 Pitot head fairing (port and starboard)
113 D/F loop bullet fairing
114 Port mainwheel
115 Flight deck underfloor control linkage
116 Wingroot/fuselage fairing
117 Wing front spar/fuselage attachment
118 Battery access panels (wingroot leading edge)
119 No 3 engine nacelle spar bulkhead
120 Intercooler pressure duct
121 Mainwheel well
122 Oil tank (nacelle inboard wall)
123 Nacelle structure
124 Exhaust
125 Retracted mainwheel (semi-recessed)
126 Firewall
127 Cooling gills
128 Exhaust collector ring assembly
129 Three-blade propellers
130 Undercarriage retraction struts
131 Starboard mainwheel
132 Axle
133 Mainwheel oleo leg
134 Propeller reduction gear casing
135 1,200 hp Wright R-1820-65 radial engine
136 Exhaust collector ring
137 Engine upper bearers
138 Firewall
139 Engine lower bearers
140 Intercooler assembly
141 Oil tank (nacelle outboard wall)
142 Supercharger
143 Intake
144 Supercharger waste-gate
145 Starboard landing light
146 Supercharger intake
147 Intercooler intake
148 Ducting
149 No 4 engine nacelle spar bulkhead
150 Oil radiator intake
151 Main spar web structure
152 Mid-wing fuel tank rib cut-outs
153 Auxiliary mid spar
154 Rear spar
155 Landing flap profile
156 Cooling air slots
157 Starboard outer wing fuel tank (nine inter-rib cells)
158 Flap structure
159 Starboard aileron
160 Outboard wing ribs
161 Spar assembly
162 Wing leading-edge de-icing boot
163 Aileron control linkage
164 Wing corrugated inner skin
165 Wingtip structure
166 Starboard navigation light







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# B-17 Flying Fortress in Action

One of the most famous bombers of all time, the Boeing B-17 was so impressive when the prototype appeared in July 1935 that it was dubbed 'the Flying Fortress'. The name stuck and became a registered trademark. The US Army Air Corps had merely asked for a 'multi-engine' bomber, to carry a 2,000-lb (907-kg) bombload. Rival companies built twin-engine machines, but Boeing went for four engines to get more speed and altitude. Eventually the first B-17 was delivered on 1 March 1937, with a crew of eight distributed around the tube-like fuselage, five of them each manning a defensive machine-gun. Amidships was a short but deep bomb bay housing up to 2177 kg (4,800 lb) of bombs, with a catwalk down the centre.

By 1940 the production model was the B-17C, with 1,200-hp (895-kW) turbosupercharged Cyclone engines giving a maximum speed of 515 km/h (320 mph), much faster than later models. In 1941 the RAF was given 20 because the US Army wanted to see how this model, with more guns, self-sealing tanks and armour, performed in combat. The result was a disaster, nine being destroyed in a few weeks, but a lot of the trouble was bad luck and bad management. Enough was learned, however, for Boeing to redesign the B-17 and the resulting B-17E flew on 5 September 1941.

The B-17E had a giant dorsal fin, giving better bombing accuracy at high altitudes, and a larger tailplane. There
changes, but the main di
cally better defensive fire
mm (0.5-in) Brownings and
mm (0.3-in) calibre. Th
manually aimed from the
weapons were in a two-gu
sal turret, a twin manual i
of the radio compartmen
positions, a manual tail tu
previously a blind spot) an
a powered ball turret wh
be small. In the event of a
turret had to be vacated,
med the whole turret had
the aircraft by a special
board, the occupant then e
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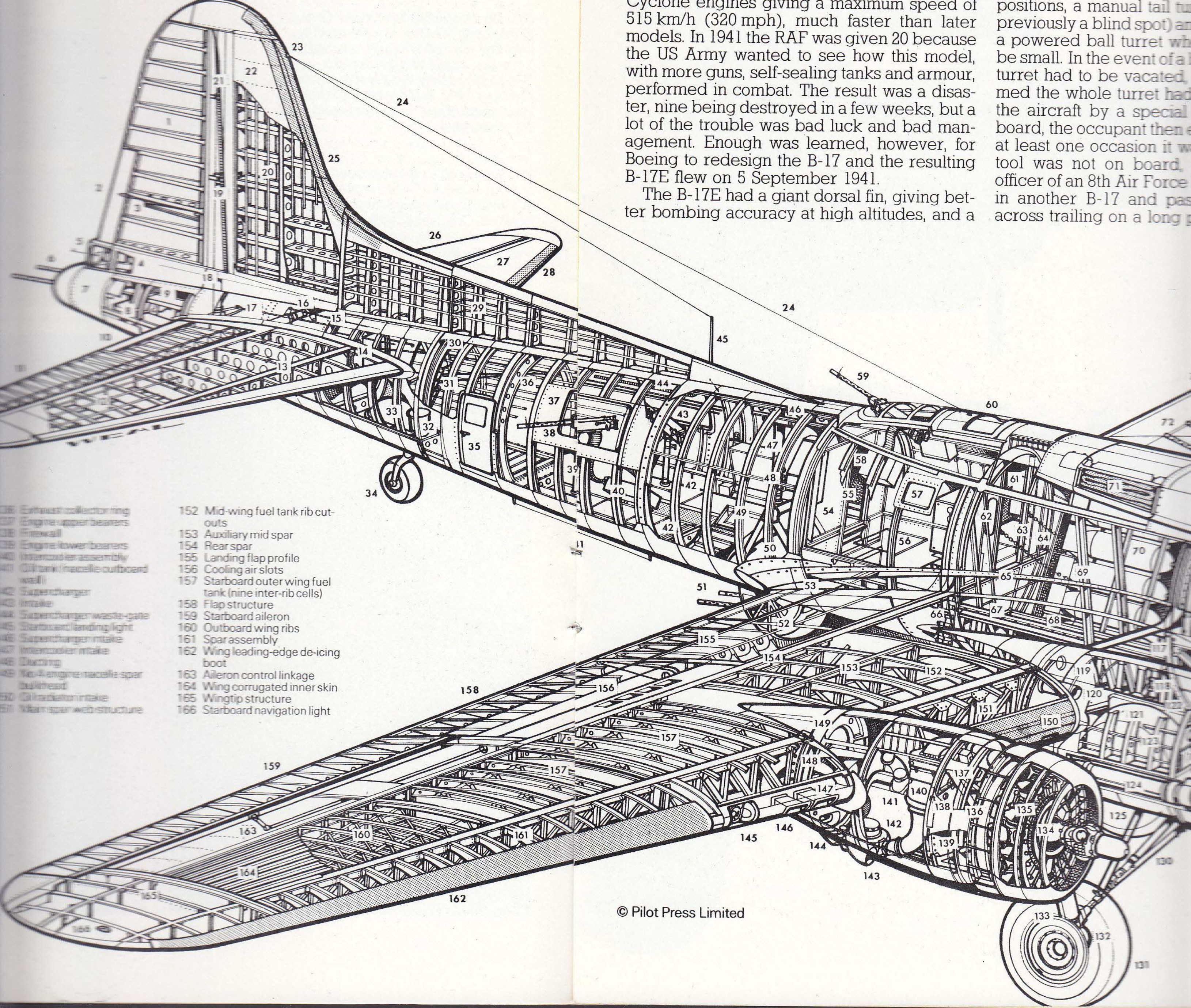

36 Exhaust collector ring
37 Engine upper bearers
38 Firewall
39 Engine lower bearers
40 Intercooler assembly
41 Oil tank (nacelle outboard wall)
42 Supercharger
43 Intake
44 Supercharger waste-gate
45 Starboard landing light
46 Supercharger intake
47 Intercooler intake
48 Ducting
49 No 4 engine nacelle spar bulkhead
50 Oil radiator intake
51 Main spar web structure
152 Mid-wing fuel tank rib cut-outs
153 Auxiliary mid spar
154 Rear spar
155 Landing flap profile
156 Cooling air slots
157 Starboard outer wing fuel tank (nine inter-rib cells)
158 Flap structure
159 Starboard aileron
160 Outboard wing ribs
161 Spar assembly
162 Wing leading-edge de-icing boot
163 Aileron control linkage
164 Wing corrugated inner skin
165 Wingtip structure
166 Starboard navigation light

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# B-17 Flying Fortress in Action

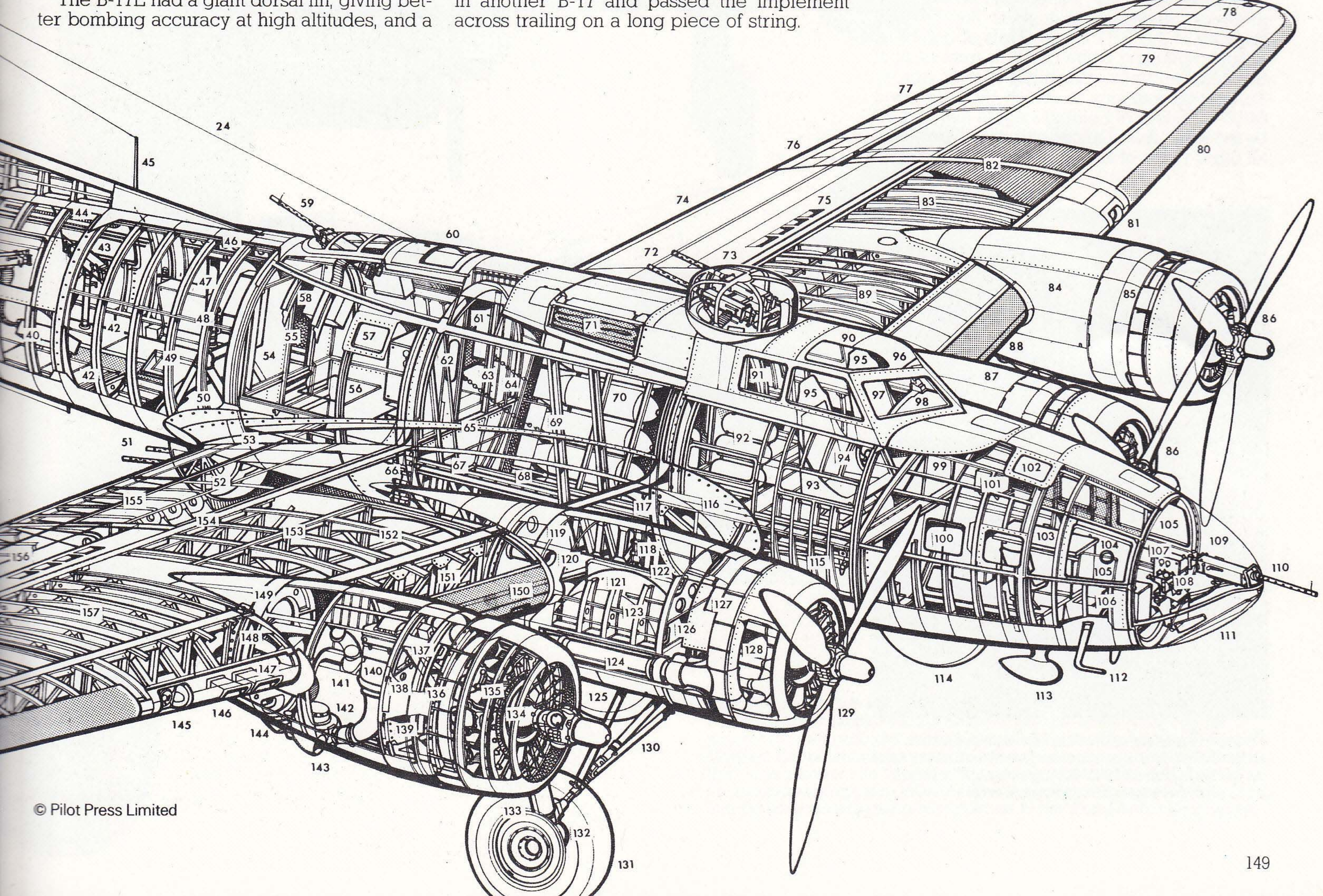
***An unusually clean B-17G is marshalled to a halt on delivery to a unit in England. Such pristine condition would not be long-lived; nose art and battle damage would soon make the aircraft look more businesslike.***

One of the most famous bombers of all time, the Boeing B-17 was so impressive when the prototype appeared in July 1935 that it was dubbed 'the Flying Fortress'. The name stuck and became a registered trademark. The US Army Air Corps had merely asked for a 'multi-engine' bomber, to carry a 2,000-lb (907-kg) bombload. Rival companies built twin-engine machines, but Boeing went for four engines to get more speed and altitude. Eventually the first B-17 was delivered on 1 March 1937, with a crew of eight distributed around the tube-like fuselage, five of them each manning a defensive machine-gun. Amidships was a short but deep bomb bay housing up to 2177 kg (4,800 lb) of bombs, with a catwalk down the centre.

By 1940 the production model was the B-17C, with 1,200-hp (895-kW) turbosupercharged Cyclone engines giving a maximum speed of 515 km/h (320 mph), much faster than later models. In 1941 the RAF was given 20 because the US Army wanted to see how this model, with more guns, self-sealing tanks and armour, performed in combat. The result was a disaster, nine being destroyed in a few weeks, but a lot of the trouble was bad luck and bad management. Enough was learned, however, for Boeing to redesign the B-17 and the resulting B-17E flew on 5 September 1941.

The B-17E had a giant dorsal fin, giving better bombing accuracy at high altitudes, and a larger tailplane. There were many internal changes, but the main difference was in radically better defensive firepower, with 10 12.7-mm (0.5-in) Brownings and two or three of 7.62-mm (0.3-in) calibre. The small guns were manually aimed from the nose, while the big weapons were in a two-gun power-driven dorsal turret, a twin manual installation in the roof of the radio compartment, two manual waist positions, a manual tail turret (filling what was previously a blind spot) and under the fuselage a powered ball turret whose occupant had to be small. In the event of a belly landing the ball turret had to be vacated, and if the door jammed the whole turret had to be severed from the aircraft by a special spanner carried on board, the occupant then escaping as it fell. On at least one occasion it was found the special tool was not on board, and the operations officer of an 8th Air Force bomb group took off in another B-17 and passed the implement across trailing on a long piece of string.

In April 1942 the B-17F introduced many improvements including a frameless Plexiglas nose which in later versions had two 12.7-mm (0.5-in) guns in left and right cheek mountings. Hundreds of B-17Fs formed the backbone of the growing might of the 8th Air Force, which from August 1942 operated over Germany and other European countries. After much action the Luftwaffe decided head-on attacks were especially effective and to counter these the main change in the B-17G was to add a chin turret with two more guns, making a total of 13, all of 12.7-mm (0.5-in) calibre (only one gun was fitted in the roof of the radio compartment, making the odd number, and later this was often omitted). The B-17G was the final mainstream variant, and 8,680 were built, the last 7,000 or so being unpainted instead of olive-drab.



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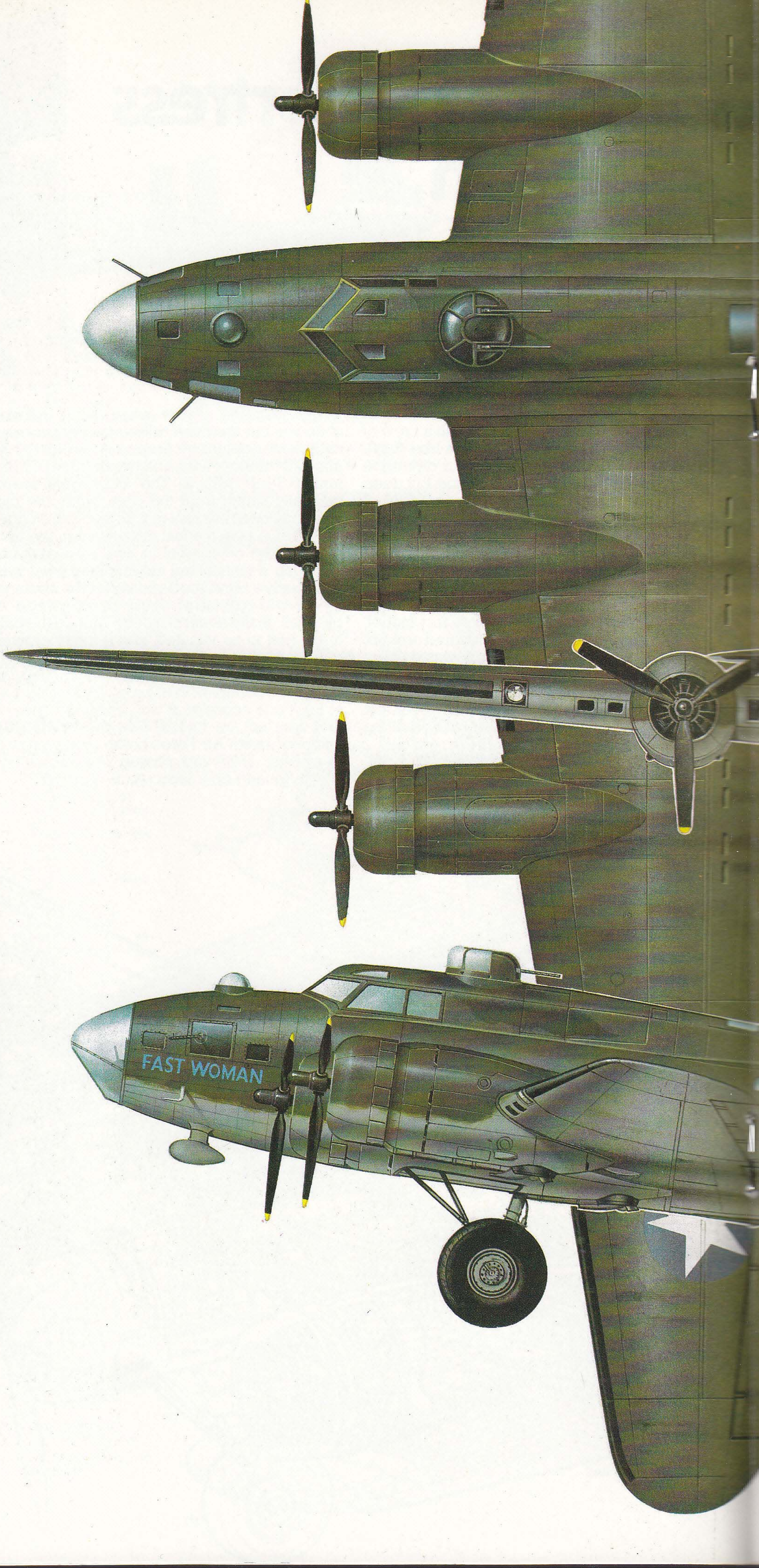
# B-17 Flying Fortress in Action

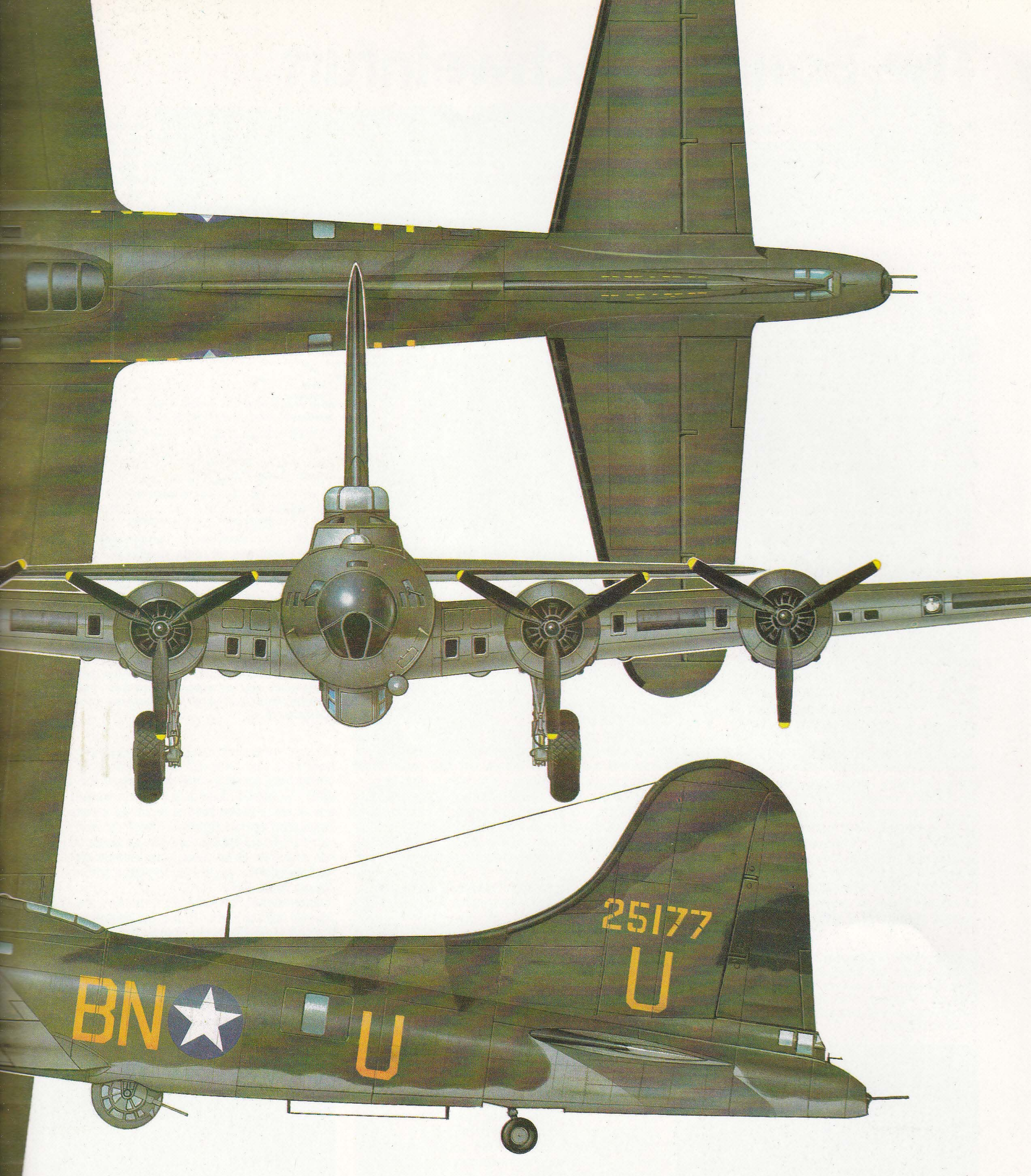
Compared with its later rival, the Consolidated B-24, the B-17 was rather simpler, less demanding to fly and certainly easier to bring home with severe battle damage and a tired and wounded crew. At the same time the concept of mass day bombing demanded the use of vast formations, so that hundreds of guns could fire on each incoming fighter. Holding station on missions lasting up to 10 hours was an exhausting task, and it was not uncommon for aircraft to be damaged or destroyed in collisions. Compared with the B-17C the fully laden B-17G could be almost 70 per cent heavier, and this made it a sluggish performer, thundering upwards for over 40 minutes before passing the 6100-m (20,000-ft) level and cruising at a mere 290 km/h (180 mph). Each mission thus became a severe test of endurance, though after long experience the original problems of intense cold, which froze guns and even crew members (especially the waist gunners, standing knee-deep in spent shell-cases at their open window hatches) were largely overcome, to the point that an aborted mission was rare.

## Multi-mission

Bombloads varied from 1814 kg (4,000 lb) on typical European missions up to an amazing 9435 kg (20,800 lb) using external racks. In a few missions stand-off guide bombs or vertical guided bombs were used, and U-boat pens were sometimes attacked by rocket-boosted bombs which impacted at supersonic speed. Altogether 12,731 B-17s were built, over 200 serving with RAF Coastal Command and the secret No. 100 Group on electronic countermeasures carrying 'Jostle' high-power jammers and other special devices. But the main memory of the B-17 is vast fleets of bombers, leaving spiralling white contrails from each of the four engines, rumbling slowly across Europe on missions in which they dropped 640,036 US tons of bombs, a figure just pipped by the RAF's Avro Lancaster but far in excess of all other types of bombers in history.

*Flying Fortresses of the 8th Air Force release a cascade of bombs on smoke markers during a raid on Berlin in March 1945. Flying in tight formation, each ship gave anti-aircraft cover to its companions.*

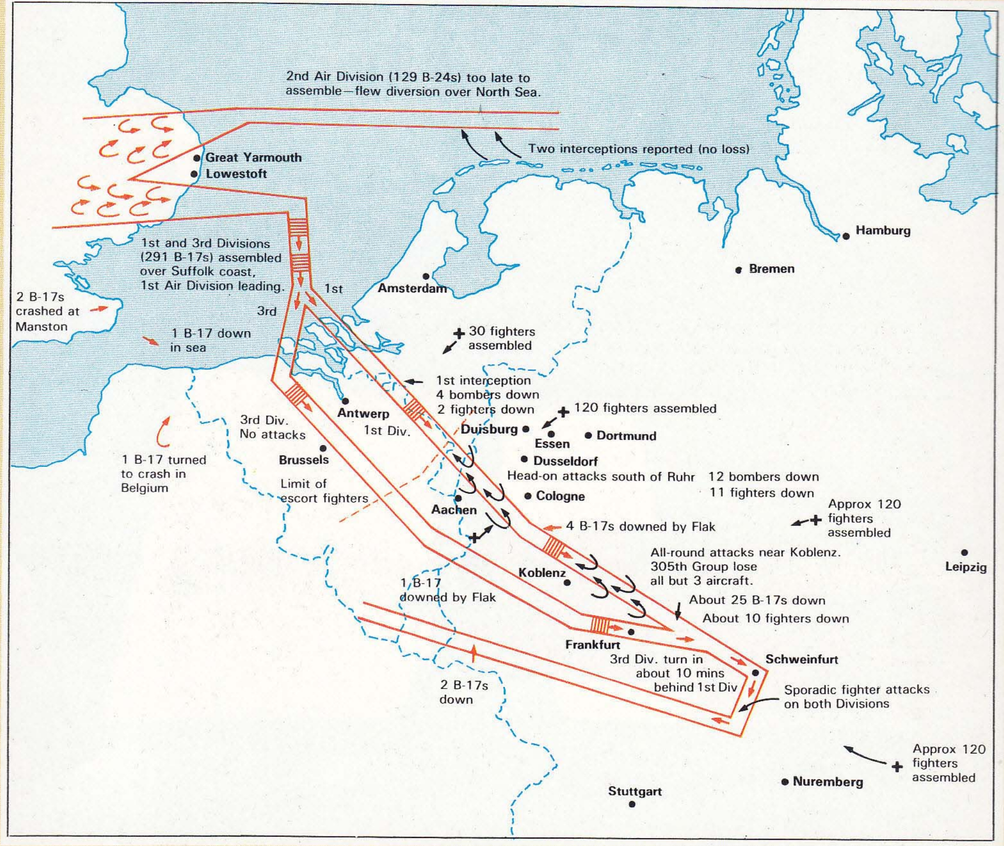




Fast Woman *was a B-17F-40-BO, built by Boeing in Seattle, and attached to the 303rd Bomb Group's 359th Bomb Squadron. She is shown as the group's aircraft probably looked when they began their assaults on German targets late in January 1943, flying from their base at Molesworth, Huntingdonshire. The 'F' model was greatly improved over earlier Fortresses; more power, more and better armament, more fuel and increased gross weight and payload made her a tough attacker.*

# The Battle of Schweinfurt

*Envisaged as an easy way to cripple the Reich's industrial base, the horror of the Schweinfurt raids had the opposite effect in virtually crippling the confidence and commitment of the US Army Air Force. But in the American tradition, they never gave up.*


2nd Air Division (129 B-24s) too late to assemble—flew diversion over North Sea.
Two interceptions reported (no loss)
Great Yarmouth
Lowestoft
1st and 3rd Divisions (291 B-17s) assembled over Suffolk coast, 1st Air Division leading.
1st
3rd
2 B-17s crashed at Manston
1 B-17 down in sea
Amsterdam
Hamburg
Bremen
30 fighters assembled
1st interception 4 bombers down 2 fighters down
120 fighters assembled
Antwerp
3rd Div. No attacks
1st Div.
Duisburg
Essen
Dortmund
Dusseldorf
1 B-17 turned to crash in Belgium
Brussels
Limit of escort fighters
Head-on attacks south of Ruhr
12 bombers down 11 fighters down
Cologne
Aachen
Approx 120 fighters assembled
4 B-17s downed by Flak
All-round attacks near Koblenz. 305th Group lose all but 3 aircraft.
Leipzig
Koblenz
1 B-17 downed by Flak
About 25 B-17s down
About 10 fighters down
Frankfurt
3rd Div. turn in about 10 mins behind 1st Div
Schweinfurt
2 B-17s down
Sporadic fighter attacks on both Divisions
Approx 120 fighters assembled
Nuremberg
Stuttgart

***The road to Schweinfurt was a bloody path to follow; flak, fighters and accidents took their toll. Some of the end formations found their way back home by tracking the string of burning wrecks on the ground.***

Doggedly pursuing its daylight bombing campaign, the USAAF's 8th Air Force based in the UK was, by mid-1943, adequately powerful to extend its operations deep into Germany; the prerequisite, in the absence of escort fighters capable of accompanying the entire raid, was to launch sufficient numbers of bombers to swamp the enemy fighter opposition. Belief that the German ball-bearing industry, centred at Schweinfurt in southern Germany, represented a vital component in the enemy's war industry that might be severely damaged in a single heavy raid, prompted its selection for attack by the 8th Air Force's newly-designated 1st Combat Bombardment Wing (Heavy) in August 1943.

The original plan (Operation 'Juggler') called for the despatch of 150 Boeing B-17Fs of the 4th CBW (Heavy) to bomb the big Messerschmitt factory at Regensburg-Prüfening and then to fly on to bases in North Africa, taking off shortly before the 240 B-17Fs of the 1st CBW which were to attack Schweinfurt. British and American Supermarine Spitfires and Republic P-47s would provide penetration cover as far as Brussels for the Regensburg raid, thereby attracting the great majority of enemy fighters into the air too soon to interfere seriously with the main raid on Schweinfurt by forcing them to land and refuel at the critical time as the main force pushed through.

## Early losses

From the outset of the raids, which were launched on 17 August, bad weather destroyed these carefully laid plans. Thick fog over the 4th CBW's bases delayed the Regensburg raiders, but eventually they were ordered off so as to ensure their arrival over the African bases in daylight. However, being based farther inland in the UK, where the fog persisted longer, the 1st CBW was unable to take off until three-and-a-half hours later, by which time the covering fighters were themselves on the ground refuelling. Furthermore the 4th CBW had attracted the undivided attention of the German defences, losing 24 B-17s (from the 94th, 95th, 96th, 100th, 385th, 388th and 390th Bomb Groups) of the 146 aircraft that crossed the enemy coast.

*Early morning briefing for 8th Air Force B-17 crews prior to a raid over the Reich. The prospects were bad; the actuality was much worse. The B-17 could take a lot of damage, but the crews were as vulnerable as ever, and many ships returned with dead and dying.*

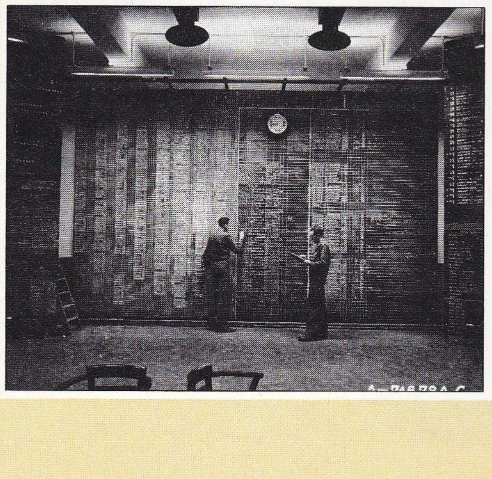
By the time the 1st CBW reached the Belgian coast the enemy fighters had rearmed and refuelled and were again on the alert; and fighters that had been called from distant sectors of the Reich earlier in the day were now concentrated in the very areas to be covered by the Schweinfurt raiders. As 230 B-17Fs of the 91st, 92nd, 303rd, 305th, 306th, 351st, 379th, 381st and 384th Bomb Groups entered Belgian skies the leading box of 60 bombers was assaulted by successive waves of fighters from JG 26, followed by elements of JG 2, JG 3 and I/JG 5. Before the target was reached and bombed at 14.57, this one box had lost 21 aircraft, and seven others had turned for home without bombing. In all, the target was struck by 183 B-17s despite the persistent attempts by the fighters. By the time the 1st CBW arrived back over its bases it had lost 36 aircraft together with 371 crew members; 19 other B-17s were withdrawn from the combat-ready list for lengthy repairs.

Subsequent reconnaissance disclosed that only two of the five vital ball-bearing plants had been significantly damaged (the VKF and KGF facilities); post-war intelligence showed that bearing production was reduced by only 21 per cent, and then for not more than three weeks. Indicative of American realization that the raid had failed in its aim was reflected in the absence of any Distinguished Unit Citations among the 1st CBW's groups; by contrast, every one of the 4th CBW's groups that had bombed Regensburg won a DUC.

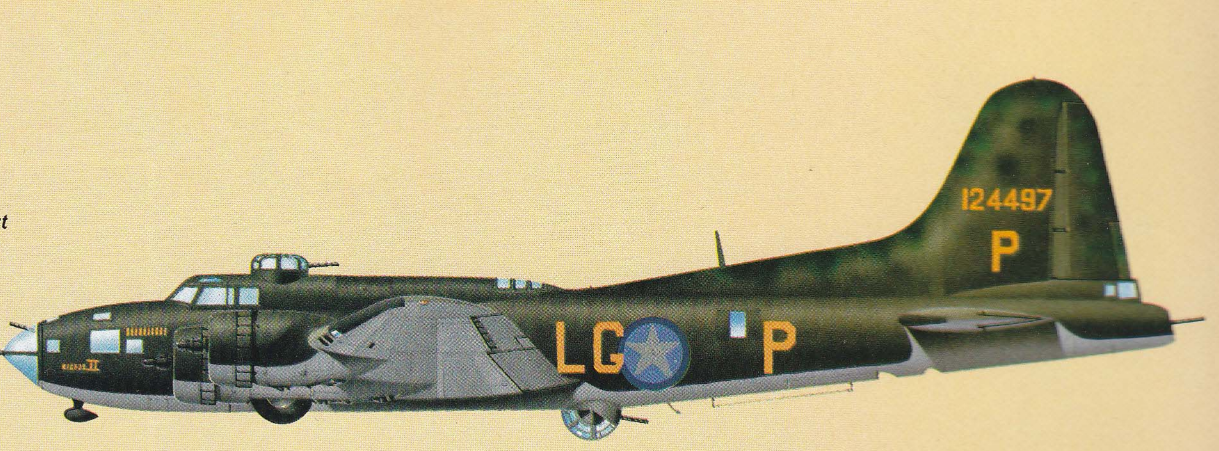
As combat reports were studied it became all too clear that, with the current level of German ability and determination to resist the deep penetration raids, the unescorted daylight raid plan was failing. An immediate outcome was accelerated delivery of the B-17G with increased forward gun armament (in a chin turret); in the longer term the range of the American escort fighters (the P-47 and Lockheed P-38) was progressively increased by the use of larger droptanks, until eventually these two types were joined by the superlative North American P-51D.

Unknown to the Americans at the time, the 17 August raid on Schweinfurt prompted the Germans to start dispersing the ball-bearing indus-

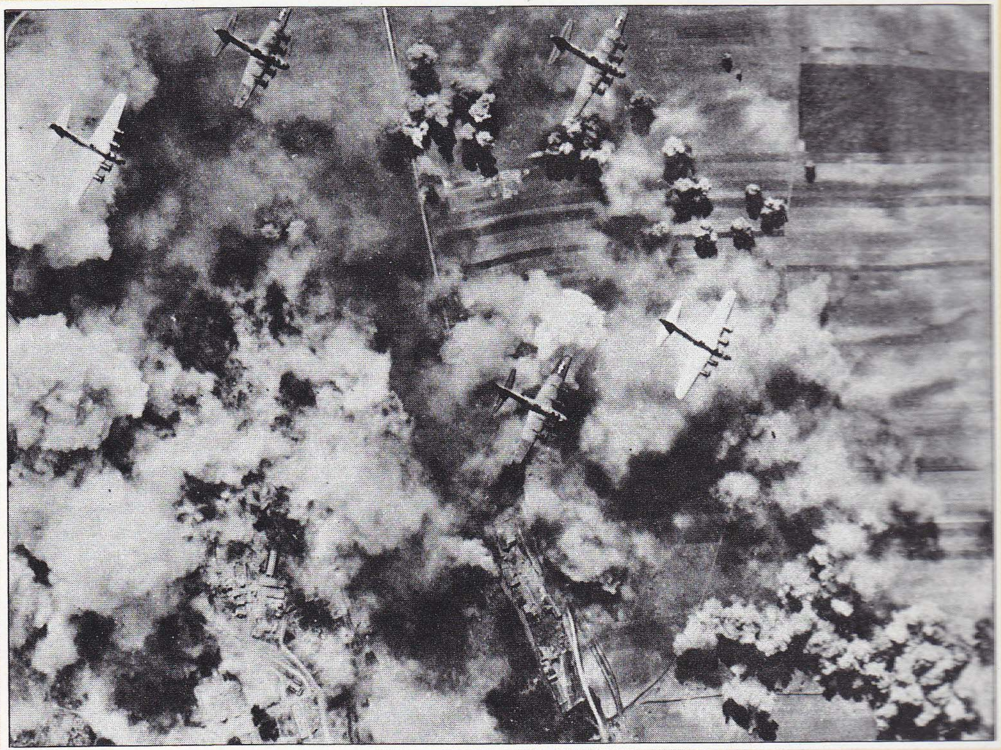
***Keeping tally of the day's mission at Kimbolton airfield, home of the 379th Bomb Group. Losses of aircraft and men on the first Schweinfurt raid were so heavy that the USAAF nearly stopped daylight strategic bombing.***



*Boeing B-17F-10 BO of 322nd Sqn of the 91st Bomb Group based at Bassingbourn, Cambs, under the 1st Bombardment Wing. No group was more famous than the 91st, which claimed the highest number of enemy aircraft destroyed and suffered the heaviest losses in the war. The markings are those of Spring 1943 vintage.*



*Right: A formation makes the halfway stage of the mission. Now for the long haul back, coping with interceptions, flak, battle damage, freezing, injuries and sheer exhaustion.*

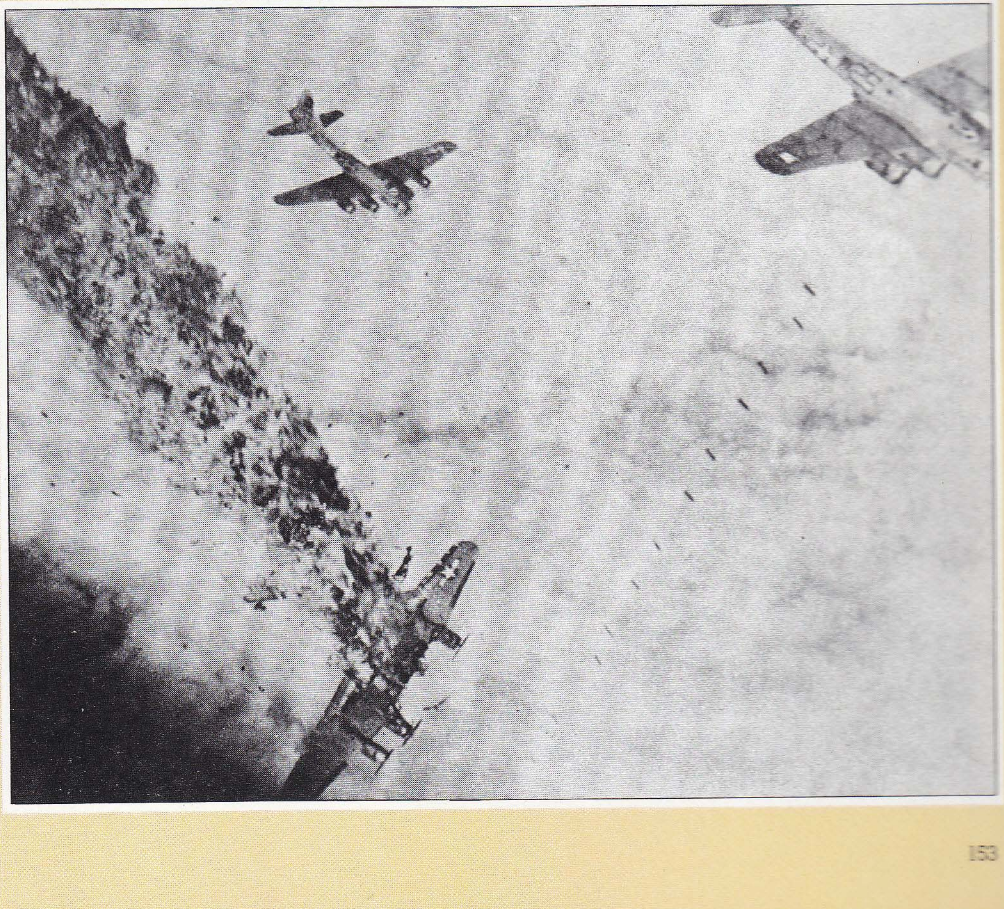


try throughout Germany. A second heavy raid was launched on 14 October by 420 B-17s and Consolidated B-24s. Once again bad weather interfered and prevented the B-24 element from assembling with the B-17s, and it was accordingly ordered to fly a diversionary feint over the North Sea. Thus it was that no more than 291 B-17s eventually set out for Schweinfurt, the leading 1st Division flying an almost direct route to the target, and the following 3rd Division following a dogleg route in an attempt to confuse the enemy as to its eventual target. The former therefore took the brunt of the German fighter reaction, the 305th Bomb Group, for instance, losing 14 of its 17 aircraft. Once more 60 American bombers were lost to the Luftwaffe, the majority of them to the pilots of I Jagdkorps. Ironically, on this occasion the bombing results were judged to be excellent – against an industrial target that had largely disappeared. Even the claims by the American B-17 gunners to have destroyed 288 enemy fighters had eventually to be confirmed as no more than 53.

## Schweinfurt martyrs

The American 1st Division again raided Schweinfurt on 24 February 1944 when 238 B-17Fs and B-17Gs, this time with long-range fighter escort, took off for the long flight over Germany, losing only 11 of their number. The RAF now took a hand, and on the same night 663 Handley Page Halifaxes and Avro Lancasters dropped 2,000 tons of bombs. And on the night of 30-31 March 1944, during the disastrous RAF raid on Nuremberg, more than 100 Halifax and Lancaster crews dropped about 400 tons of bombs in the Schweinfurt area, believing it to be Nuremberg. Further attacks by the 8th Air Force B-17s and B-24s were flown by day on 21 July and 9 October 1944 against Schweinfurt, and the last raid, by medium bombers of the US 9th Air Force, took place in April 1945.

While the martyrdom of Schweinfurt assumed the proportions of an American bombing epic, it served well to demonstrate the characteristic flaws in the whole Allied strategic bombing plan: that no decisive result would be achieved through bombing without comprehensively accurate intelligence as to the enemy's ability to disperse his vital war targets, and without prior winning of air superiority in the enemy's air space.



*Right: Flame, smoke and debris stream from a dying B-17 after flak had torn off the entire nose section with the pilot, co-pilot, bombardier and navigator inside.*

# The Ploesti Oil Raids

***'Halt the supply of Hitler's oil' was the simple objective behind the Ploesti raids. The achievement of that objective involved the Americans in perhaps the most dramatic air campaigns of the war.***

Effectively deprived of oil from overseas throughout World War II, Germany became heavily dependent upon the output of the Romanian oilfields after her attack on the USSR in June 1941, and the vast refining complex at Ploesti (supplying the German forces with some 60 per cent of their natural oil requirements) soon attracted the attention of Allied strategic planners.

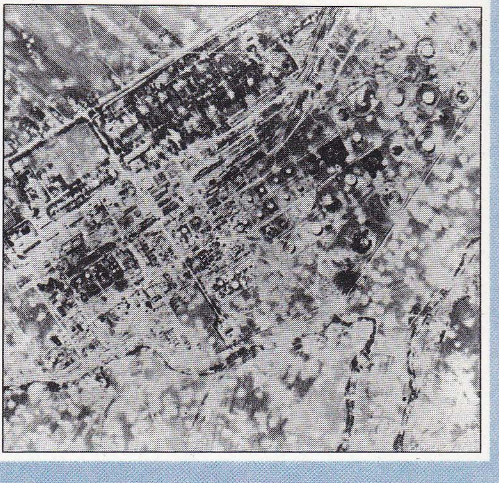
Only in June 1942, with the passage through the Middle East of Consolidated B-24D bombers, did aircraft of sufficient range to reach Ploesti become available, and 13 such aircraft were flown against the target on 11-12 June. Only very light bombloads could be carried on the flight from Fayid in Egypt and, as a result of bad weather over Romania, few bombs found their target and little damage resulted. The bombers encountered no opposition, but six aircraft force-landed in Turkey and Syria. The raid, beyond confirming the ability of the B-24 to cover the distance, achieved nothing but to warn the Germans of the danger, who proceeded to deploy heavy gun and fighter defences in the area.

This failure did nothing to deter the Americans who, a year later, planned to mount a heavy, low-level raid by five groups of B-24s. As only two such groups, the 98th and 376th Bomb Groups (Heavy), were then operational in North Africa, three others (the 44th, 93rd and 389th) were transferred from the UK to Benghazi in Libya when the raid, codenamed 'Tidal Wave', was to be launched. A total of 179 bombers took off early on 1 August 1943 and set course for Corfu; two aircraft were lost through accidents early on, one being the lead aircraft of the 376th (leading) Group, a loss that caused such confusion that three groups failed to make a correct course alteration.

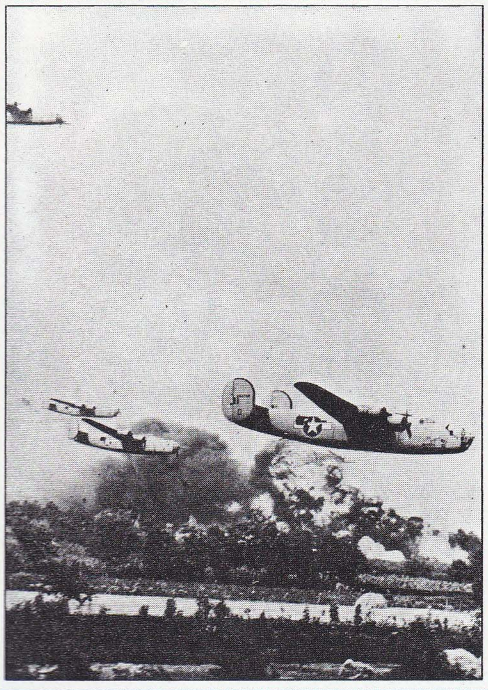
The force was now heading for Romania in two formations, one of which found itself approaching Bucharest having missed a turning point; leading the 93rd Group, Colonel Addison Baker spotted the refineries and turned the formation towards the target. Confused by their direction of approach and in the face of intense ground fire from the thoroughly alerted defences, the pilots had difficulty in identifying their briefed objectives and simply bombed targets of opportunity. The B-24s of the 44th, 98th and 389th Groups now arrived, only to find their assigned targets covered by rolling clouds of dense black smoke and a wall of flak. The group commanders displayed great skill and courage in finding and attacking other plants in the target complex, but suffered considerable casualties. The 44th Group lost seven out of 16 aircraft to flak, the 98th 13 out of 41. As the B-24s emerged from the blazing target area German fighters were waiting, and to the loss from flak of 33 bombers were now added eight more to Messerschmitt Bf 109s. Seven others force landed in Turkey, two collided and one ditched in the sea. Thus a total of 52 bombers from the force of 179 despatched was lost, and 58 more were badly damaged. Only two of the 44th Group's B-24s returned, including that of its commander, Colonel Leon Johnson, who was awarded the Medal of Honor; four other Medals of Honor were awarded to participants (three of them posthumously), a unique recognition for a single operation. Moreover, all five groups received Distinguished Unit Citations.

Despite the confused nature of the attack, the raid nevertheless succeeded in destroying two of the principal component plants, and the Ploesti complex was unable to regain full production for eight months, during which time the Allies had advanced north in Italy, thereby halving the distance between suitable bomber bases and the target. Apart from a number of bombs which fell at Ploesti during a raid on nearby marshalling yards on 5 April 1944, the next formally briefed raid on the oil refineries was carried out by 206 B-24s of the 15th Air Force on 18 May that year. Heavy damage was again caused despite the introduction by the Germans of an elaborate system of smoke screens. A change in tactics, involving the use of some 70 Lockheed P-38 fighters and fighter-bombers, was employed in a low-level attack on 10 June – with the prohibitive loss of 24 aircraft.

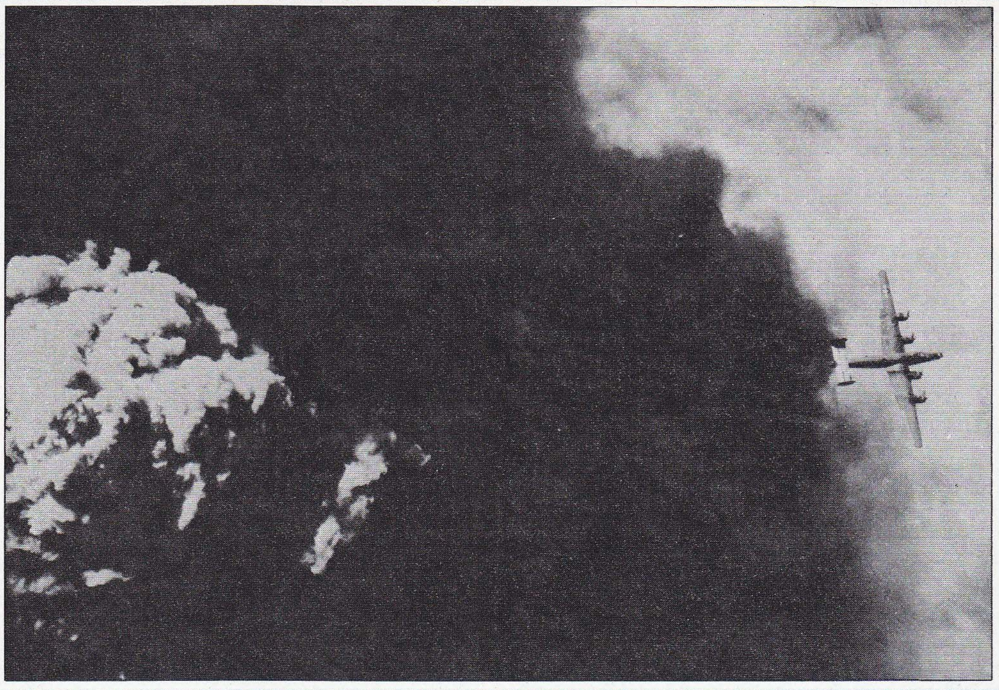
Between 5 April and the end of August, when Ploesti was overrun by the Soviets, a total of 19 attacks was carried out by the 15th Air Force's B-17s and B-24s, which dropped 13,469 tons of bombs in the course of 5,479 sorties, for the loss of 223 aircraft. Deprived of Ploesti's oil, Germany was forced to depend almost entirely on the manufacture of synthetic oil, an industry that was itself to become paramount among Allied bombing objectives in the final eight months of the war.



***Devastation of the Romano Americana oil refinery after a strike by B-24s from Italy. Oil supplies from Romania finally dried up just before the Soviet armies arrived.***



***Flying low into the inferno of a flaming oil refinery, a group of B-24D Liberators surge towards their own targets.***

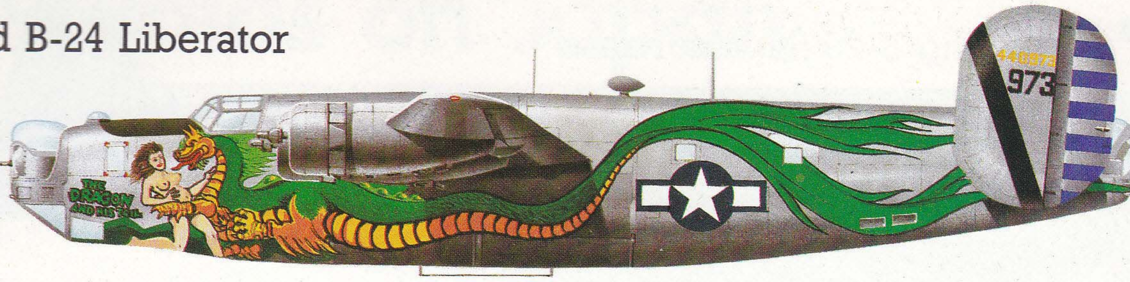


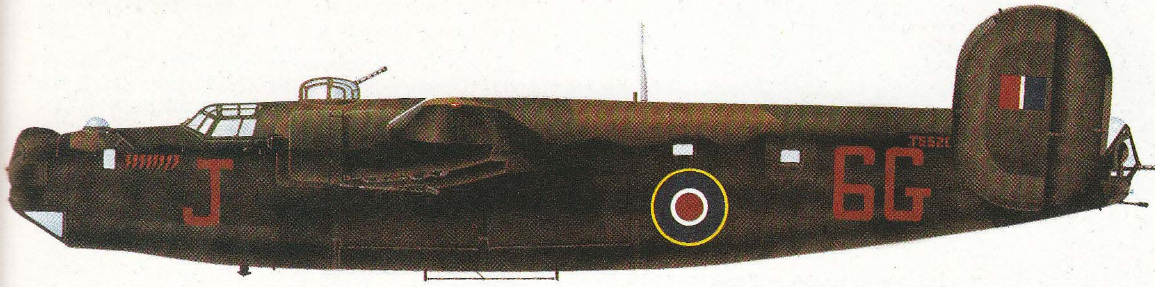
***A Liberator barely escapes from the target at Ploesti before being enveloped in the cloud of flame and smoke of a burning oil storage tank.***

USA

# Consolidated B-24 Liberator

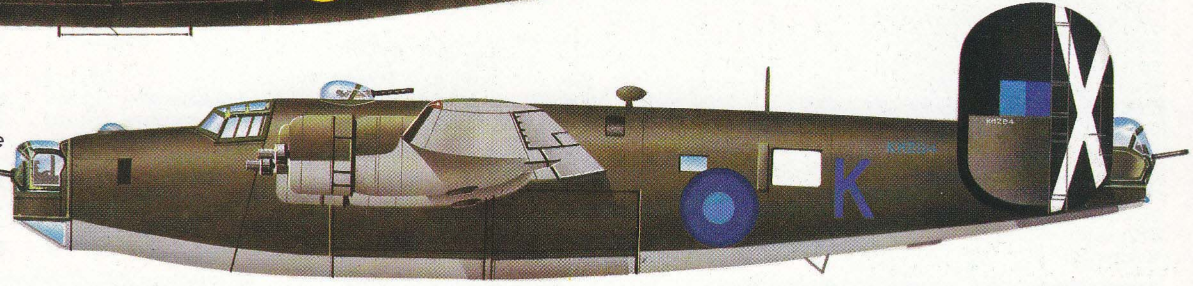
*One of the last B-24s to get into action, this B-24J-190 was given a particularly flamboyant paint job by the 43rd Bomb Group operating against the Japanese mainland from Ie Shima in the spring of 1945. The dorsal turret was omitted, reflecting the approach of victory.*





*Used as an electronic warfare aircraft, this Liberator B.Mk IV flew with No. 223 Sqn, RAF. Flying in ahead of bombing formations, these aircraft jammed German ground and night fighter radars.*

*The RAF flew several hundred Liberators in India, where they were the major weapon used to bomb Japanese targets in Burma and China.*



Produced in larger numbers than any other American aircraft during the war (and any other four-engine aircraft in history) the **Consolidated B-24 Liberator** did not enter the design stage until 1939, and the prototype **XB-24** was flown on 29 December that year. Minor development batches followed in 1940 before the first major production version, the **B-24D**, appeared late in 1941. A policy decision to concentrate B-24s primarily in the Pacific theatre (where the type's long range was used to good effect) resulted in most of the 2,738 B-24Ds being deployed against Japan, but the 8th and 9th Air Forces in Europe and North Africa also received the aircraft, one of their outstanding raids being the attack on the Ploesti oil refineries on 1 August 1943. A total of 791 **B-24E** bombers with changed propellers was produced before production switched to the **B-24G**, of which 430 were built. This version introduced a two-gun nose turret to counter German head-on fighter attacks and was followed by 3,100 **B-24H** aircraft with various makes of nose turret. Major production version was the **B-24J**, of which 6,678 were built, incorporating a Motor Products nose turret, new-type autopilot and bombsight. The **B-24L** (1,667 built) featured two manually operated tail guns in a Consolidated turret, and the **B-24M** (2,593 built) introduced a Motor Products two-gun tail turret. This huge manufacturing effort (which produced a total of 18,313 aircraft in five and a half years) involved Consolidated,. Douglas, Ford and North American plants, the total including many aircraft for the RAF (in which Liberators served with 42 squadrons) and US Navy (with whom Liberators served under the designation **PB4Y**) and also the 25-passenger **C-87** version, of which 282 were produced.

### Specification

**Consolidated B-24J Liberator**

**Type:** eight/ten-crew daylight medium/heavy bomber

**Powerplant:** four 1,200-hp (895-kW) Pratt & Whitney R-1830-65 radial piston engines

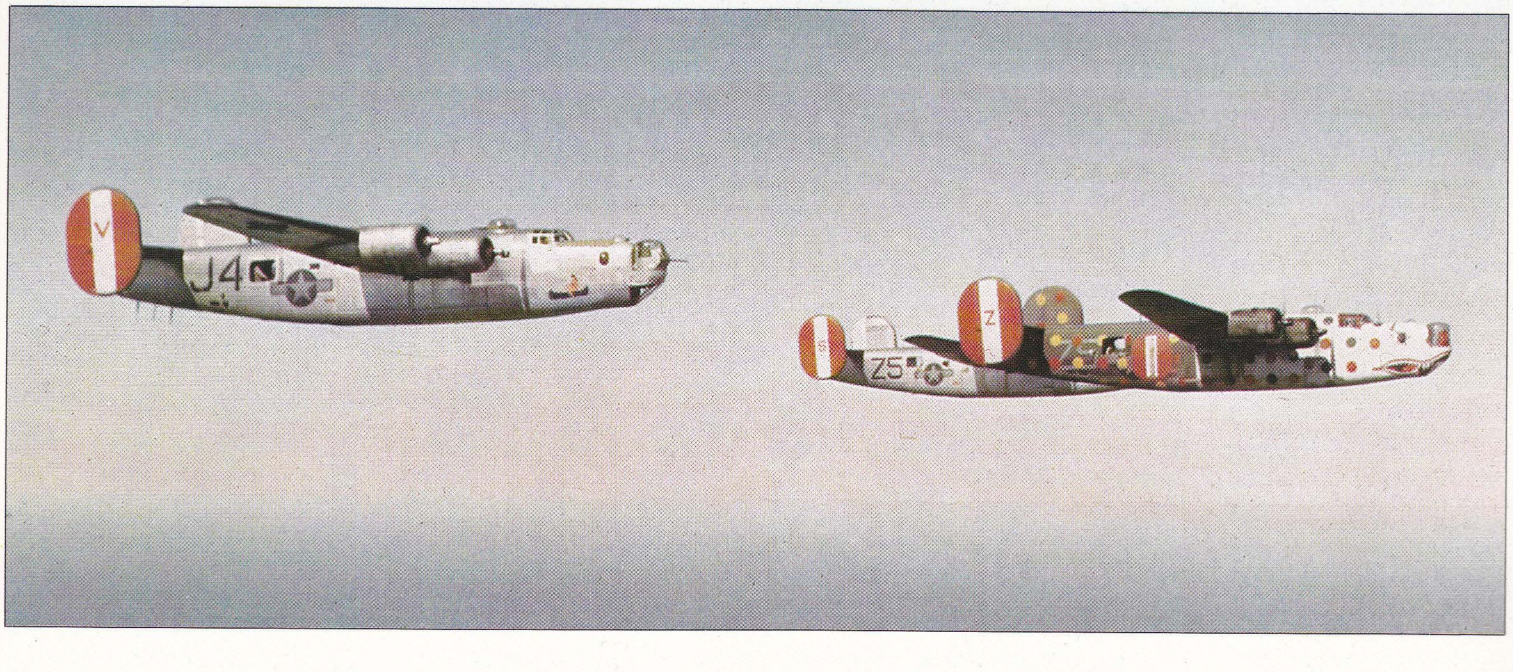
**Performance:** maximum speed 467 km/h (290 mph) at 7620 m (25,000 ft); climb to 6096 m (20,000 ft) in 25 minutes; service ceiling 8535 m (28,000 ft); range 3220 km (2,000 miles) with a 3992-kg (8,800 lb) bombload

**Weights:** empty 16556 kg (36,500 lb); maximum take-off 29484 kg (65,000 lb)

**Dimensions:** span 33.53 m (110 ft 0 in); length 20.47 m (67 ft 2 in); height 5.49 m (18 ft 0 in); wing area 97.36 m$^2$ (1,048.0 sq ft)

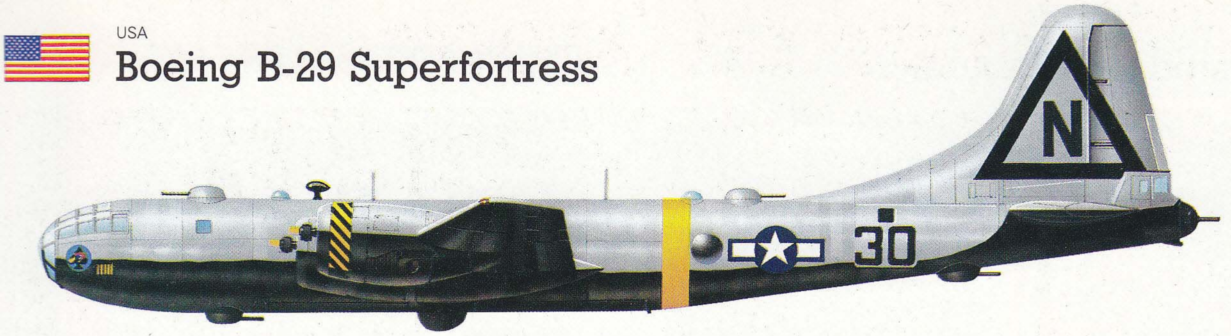
**Armament:** two-gun turrets in nose, tail, upper fuselage aft of cockpit and under centre fuselage, and single manual guns in waist (beam) positions for a total of 10 12.7-mm (0.5-in) machine-guns, plus a normal bombload of 3992 kg (8,800 lb)

***Formation flying is an art in itself, and formating a heavy aircraft while joining up in formations of 40 or more, often in partial cloud, took concentration. The Americans used brightly coloured 'assembly ships', usually with polka dots to facilitate the forming of combat boxes. Such gaudy aircraft did not fly on missions but returned to base when the formation had set course.***



USA

# Boeing B-29 Superfortress



*A feature of the B-29's gun armament was the use of remotely controlled turrets, periscopically sighted by gunners located within the fuselage. The aircraft illustrated, carrying BTO (bombing through overcast) radar, was based on Tinian for the final raids on Japan.*

Design of the **Boeing B-29 Superfortress** heavy bomber started in 1940 to meet a US Army Air Corps requirement for a 'Hemisphere Defense Weapon', an aircraft capable of carrying 907 kg (2,000 lb) of bombs for 8582 km (5,333 miles) at 644 km/h (400 mph); only after the Japanese attack on Pearl Harbor put an end to the USA's isolationism was the project given top priority, and the first **XB-29** was flown on 21 September 1942. The very big four-engine mid-wing bomber had by then been ordered in large numbers and in 1943 the decision was taken to deploy the B-29 only against Japan, concentrating the new bombers in the XX Bomber Command on bases in India and China. The first **YB-29** service test aircraft were delivered to the 58th Bomb Wing in July 1943 and were followed by **B-29-BW** production bombers three months later. Production was concentrated at Boeing, Wichita (BW), Bell, Marietta (BA), Martin, Omaha (MO), and a new Boeing-run factory at Renton (BN). Four groups of B-29s moved to India early in 1944, making their first raid on Bangkok on 5 June, and on the Japanese mainland 10 days later. For the first nine months the B-29s were principally employed in high-level daylight raids, but on 9 March 1945, when operations were run primarily from five vast bases in the Marianas islands, they switched to low-level night attacks with devastating incendiary raids on Japanese cities (the first of which on Tokyo caused 80,000 deaths). Two other main versions of the B-29 appeared during the war, the **B-29A-BN** with four-gun forward upper turret and increased wing span, and the **B-29B-BA** with reduced gun armament and increased bombload. The B-29-45-MOs *Enola Gay* and *Bock's Car* of the 393rd Bomb Squadron dropped the atomic bombs 'Little Boy' and 'Fat Man' on Hiroshima and Nagasaki on 6 and 9 August 1945 respectively, bringing the war to an end. Total B-29 production was 3,970.

### Specification

**Boeing B-29A Superfortress**

**Type:** 10-crew heavy strategic bomber

**Powerplant:** four 1641-kW (2,200-hp) Wright R-3350-57 radial piston engines

**Performance:** maximum speed 576 km/h (358 mph) at 7620 m (25,000 ft); climb to 6095 m (20,000 ft) in 38 minutes; service ceiling 9695 m (31,800 ft); range 6598 km (4,100 miles)

**Weights:** empty 32369 kg (71,360 lb); maximum take-off 64003 kg (141,100 lb)

**Dimensions:** span 43.36 m (142 ft 3 in); length 30.18 m (99 ft 0 in); height 9.01 m (29 ft 7 in); wing area 161.27 $m^2$ (1,736.0 sq ft)

**Armament:** four-gun turret over nose, two-gun turrets under nose, under and over rear fuselage, all with guns of 12.7-mm (0.5-in) calibre, and one 20-mm and two 12.7-mm (0.5-in) guns in tail, plus a bombload of up to 9072 kg (20,000 lb)

***The mighty Superfortress. One of the most remarkable achievements of the war was the design, development and production of this bomber in the space of four years. All B-29s were assigned to the assault on Japan, the two aircraft here – YB-29s – being flown by the 58th Bomb Wing (Very Heavy).***

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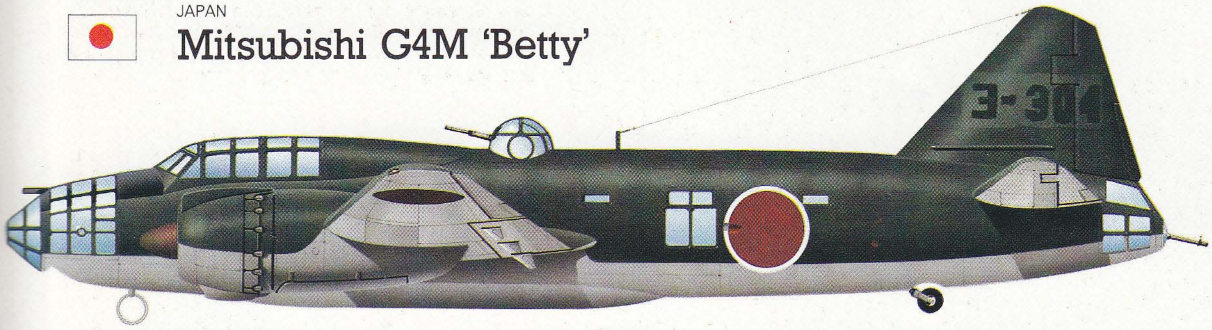
JAPAN

# Mitsubishi G4M 'Betty'



*Identified by its dihedral tailplane, the Mitsubishi G4M3 'Betty' was produced in limited numbers during the last two years of the war. The main improvement over previous models was increased protection for the crew. The aircraft portrayed flew with the Yokosuka Kokutai, Atsugi during the last days of the war.*

Codenamed **'Betty'** by the Allies, the **Mitsubishi G4M** long-range medium bomber remained in service with the Japanese navy from the first to the last day of the war: it took part in the attack that sank the British warships HMS *Prince of Wales* and HMS *Repulse* in December 1941, and it carried the Japanese surrender delegation on 19 August 1945. Designed to a 1937 requirement for a long-range bomber, the **G4M1** prototype made its first flight on 23 October 1939, and during trials recorded an extraordinary performance of a 444-km/h (276-mph) top speed and 5555-km (3,450-mile) range, albeit without bombload. The first production G4M1s (**Navy Type 1 Attack Bomber Model 11**) were initially deployed against China in mid-1941 but on the eve of the attack on Malaya the bombers moved to Indo-China and within a week had successfully attacked the *Prince of Wales* and *Repulse*. When Allied fighter opposition eventually increased to effective proportions, the G4M1 was seen to be very vulnerable, possessing little armour protection for crew and fuel tanks, and it was in a pair of G4M1s that Admiral Yamamoto and his staff were travelling when shot down by P-38s over Bougainville on 18 April 1943. Little improvement had been secured in the **Navy Type 1 Attack Bomber Model 22** with revised powerplant. The **G4M2**

# The B-29 Raids on Japan

*Boeing B-29 Superfortresses formate over Guam on their way to bomb strategic targets in Japan. The endurance of the B-29 enabled the Americans to attack Japan from vast airfield complexes built far beyond the range of enemy bombers.*

Once war with Japan became reality in December 1941, it was accepted by the United States that final victory could be achieved by only two means: an appallingly costly land invasion of the Japanese homeland, or the blasting of the enemy into submission from the air. There were no other options. And the Boeing B-29 Superfortress long-range heavy bomber was produced for exactly the latter purpose.

This aircraft had in fact been conceived in 1940 simply as a successor to the B-17, almost two years before the United States entered the war, but after Pearl Harbor great urgency was lent to the process of putting the big bomber into production; its specification was the only one that envisaged delivering a worthwhile bomb load over the vast distances involved in the Pacific war, and in general terms it possessed about twice the performance of the B-17. Once the B-29 entered production it came to be regarded as the single weapon that might bring Japan to her knees, so the application of manpower to bring this weapon into service was nothing short of prodigious.

## Giant pre-order

First flight by the prototype XB-29 took place on 21 September 1942, by which time 1,664 production aircraft had been ordered; the following June the 58th Bombardment Wing (Very Heavy) was activated at Marietta, Georgia, and seven pre-production YB-29s were delivered for crew training the following month.

Meanwhile 700,000 Chinese labourers were set to work to construct nine huge airfields, four in China and five in north east India, and a new command, the US 20th Air Force, was constituted under General of the Army Henry H. Arnold, on 4 April 1944. On 5 June India-based B-29s of the 58th BW took off to bomb railway yards at Bangkok in Thailand.

The logistic effort required to support the operations from these bases was enormous, and involved the B-29s themselves ferrying huge quantities of fuel and ordnance over the Himalayas to their staging bases in China, a task which cost many aircraft, as well as accelerated wear on engines and airframes.

The first B-29 raid on the Japanese mainland was flown on 15 June by 50 aircraft against Yawata; seven bombers were lost, but of these only one fell to the enemy. These difficult raids against Japan continued for some months with fairly heavy casualties (at least three B-29s force-landed in the USSR, where they were copied as the Tupolev Tu-4).

## Mass build-up

When American forces captured the Marianas in 1944 five great bases were constructed, two on Tinian, two on Guam and one on Saipan, each large enough to accommodate a 180-aircraft wing. The first Marianas-based raid on Japan was flown on 24 November by 111 B-29s of the 73rd Wing led by Brigadier General Emmett O'Donnell against the Musashino engine plant at Tokyo, but as a result of navigating difficulties only 24 aircraft bombed the target.

In the meantime the 58th Wing had moved to the Marianas, to be joined by the 313th, 314th and 315th Wings, representing an initial force of almost 600 aircraft. On 20 January 1944 Major General Curtis E. LeMay assumed command of the XXI Bomber Command with headquarters on Guam, his task being to initiate a series of devastating fire raids on Japan. The first such raid, on the night of 9-10 March 1945, involved 302 aircraft attacking individually from between 1525 and 3050 m (5,000 and 10,000 ft). Crews were reduced and gun armament omitted in the interests of increased bombload, which comprised more than six tons of the new M69 fire bombs, each of which was in effect a cluster of napalm containers. For the loss of 14 B-29s, 43.75 km$^2$ (16.9 sq miles) of Tokyo were reduced to ashes. Five such fire raids were flown in this initial phase against Japan, the cities of Nagoya (two raids), Osaka and Kobe sharing the fate of Tokyo.

As the Japanese fighter defences were increased to meet this tremendous onslaught, the B-29s had their tail guns reinstated, and in May raids by more than 400 aircraft were frequently flown, with losses gradually dropping from 1.3 per cent to 0.02 in August. The greatest raid was mounted on 25-26 May when 464 B-29s out of 498 despatched raided Tokyo, led by 12 pathfinders. This raid, Mission 183, resulted in over 2,200 tons of incendiaries falling on the predominantly timber-built areas of the Japanese capital, of which 48.9 km$^2$ (18.9 sq miles) were devastated. In the 200-odd fire raids carried out by the B-29s over Japan the USAAF dropped 169,676 tons of bombs, of which 105,486 tons were incendiaries. In Tokyo alone more than 80,000 people were killed and over one million rendered homeless, more than were caused by either of the two atomic bomb attacks, which were flown by B-29s of the 50th Composite Group of the 315th Bomb Wing against Hiroshima on 6 August and against Nagasaki three days later. Whether by fire or by atomic bomb, the B-29 achieved its allotted task: Japan surrendered unconditionally at midnight on 14-15 August 1945.

was therefore introduced with increased armament, increased fuel and 1,800-hp (1343-kW) Mitsubishi Kasei radials, and this version (**Navy Type 1 Attack Bomber Model 22A** and **Model 22B**) remained in production until the end of the war in steadily improved **Navy Type 1 Attack Bomber Model 24** variants. A further improved version, the **G4M3**, with increased crew protection, was also produced in small numbers as the **Navy Type 1 Attack Bomber Model 34**. Production amounted to 1,200 G4M1s, 1,154 G4M2s and 60 G4M3s.

### Specification
**Mitsubishi G4M2 'Betty'**

**Type:** seven-crew land-based naval bomber

**Powerplant:** two 1,800-hp (1343-kW) Mitsubishi MK4P Kasei 21 radial piston engines

**Performance:** maximum speed 438 km/h (272 mph) at 4600 m (15,090 ft); climb to 8000 m (26,245 ft) in 32.4 minutes; service ceiling 8950 m (29,365 ft); range 6059 km (3,765 miles)

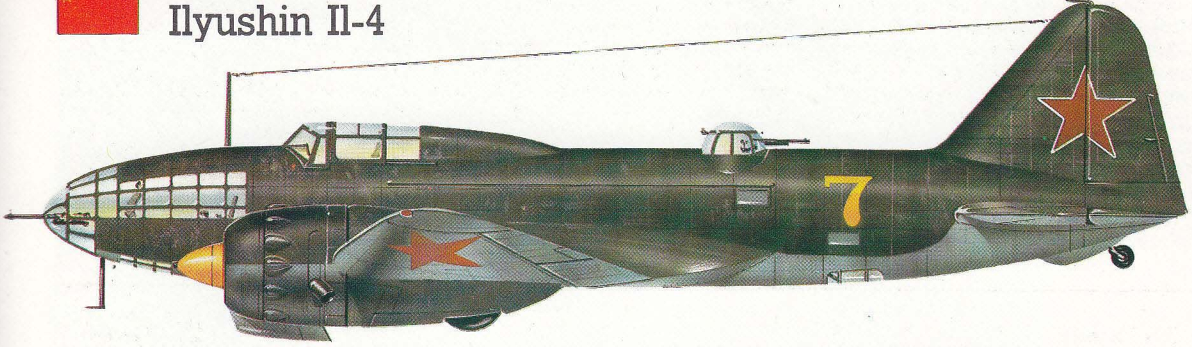
**Weights:** empty 8160 kg (17,990 lb); normal loaded 12500 kg (27,558 lb)

**Dimensions:** span 25.00 m (82 ft 0¼ in); length 20.00 m (67 ft 7⅜ in); height 6.00 m (19 ft 8¼ in); wing area 78.125 m² (840.93 sq ft)

**Armament:** two 7.7-mm (0.303-in) Type 92 machine-guns in nose, one 7.7-mm (0.303-in) Type 92 machine-gun in each side blister position, one 20-mm Type 99 cannon in dorsal turret and one 20-mm Type 99 in tail, plus 1000 kg (2,205 lb) of bombs or one 800-kg (1,764-lb) torpedo

USSR

## Ilyushin Il-4



*The Ilyushin Il-4 was roughly in the same class as the Heinkel He 111 and first saw service in the Winter War with Finland. It was the first Soviet bomber to raid Berlin, and served until the last few months of the war, when it was relegated to glider towing.*

One of the great bombers of the war, the **Ilyushin Il-4** has not unnaturally been overshadowed in Western thinking by the great British and American aircraft, yet well over 5,000 Il-4s were produced between 1937 and 1944, the vast majority in the last three years. The original prototype of this low-wing twin-engine bomber, designated the **TsKB-26**, flew in 1935, was developed through the **TsKB-30**, and entered production in 1937 as the **DB-3B** (DB being a Soviet contraction denoting long-range bomber). Early examples were powered by 765-hp (571-kW) M-85 engines, but these were replaced by 960-hp (716-kW) M-86s in 1938. Although a tough and relatively simple design, the aircraft suffered from a poor defensive armament of single nose, dorsal and ventral 7.62-mm (0.3-in) guns, and lost heavily to such aircraft as the Bristol Bulldog, Gloster Gladiator and Fokker D.XXI during the Winter War against Finland in 1939-40. In 1939 a modified version with lengthened nose and more armour (the **DB-3F**) appeared, and in 1940, in conformity with changed Russian practice, the designation became Il-4 (denoting the designer, Sergei Ilyushin). Soon after the German attack on the USSR opened in 1941 it was decided to withdraw Il-4 production to newly opening plants in Siberia, at the same time replacing a large proportion of the metal structure by less strategically critical wood. Il-4s also entered service with Soviet Naval Aviation, and it was a naval-manned force of these bombers that first raided Berlin from the east on 8 August 1941. Thereafter the Il-4 paid frequent visits to the German capital and other targets in Eastern Europe. In 1944 production ended, although the Il-4 served until the end of the war and afterwards. Apart from increasing the calibre of its guns and giving it a torpedo-carrying ability, the Il-4 remained virtually unchanged between 1941 and 1944.

### Specification
**Ilyushin Il-4**

**Type:** four-crew bomber/torpedo-bomber

**Powerplant:** two 1,100-hp (821-kW) M-88B radial piston engines

**Performance:** maximum speed 410 km/h (255 mph) at 4725 m (15,500 ft); initial climb rate 270 m (886 ft) per minute; service ceiling 10000 m (32,810 ft); range with bombload 2600 km (1,616 miles)

**Weights:** empty 6000 kg (13,228 lb); maximum take-off 10000 kg (22,046 lb)

**Dimensions:** span 21.44 m (70 ft 4¼ in); length 14.80 m (48 ft 6½ in); height 4.10 m (13 ft 5½ in); wing area 66.7 m² (718.0 sq ft)

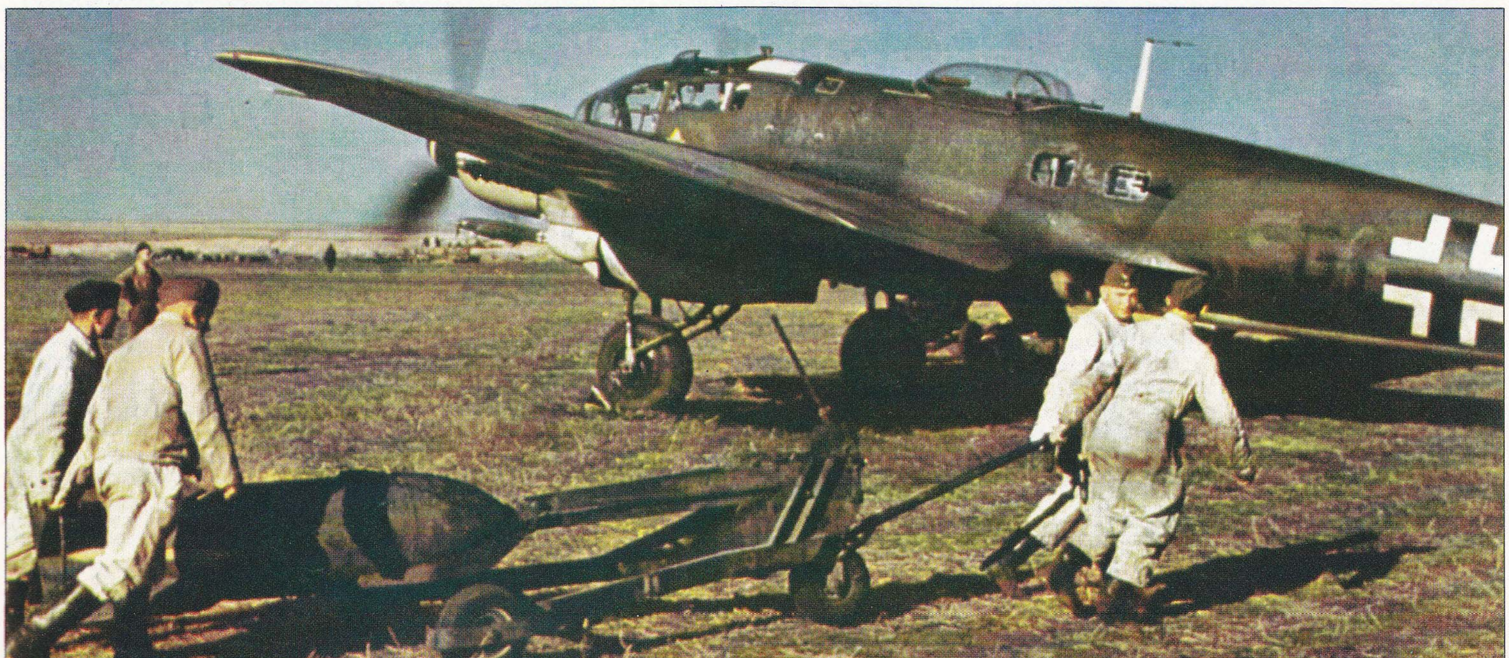
**Armament:** single 12.7-mm (0.5-in) UBT machine-guns in nose, dorsal turret and ventral positions, plus a maximum bombload of 1000 kg (2,205 lb) or three 500 kg (1,102 lb) torpedoes

GERMANY

## Heinkel He 111

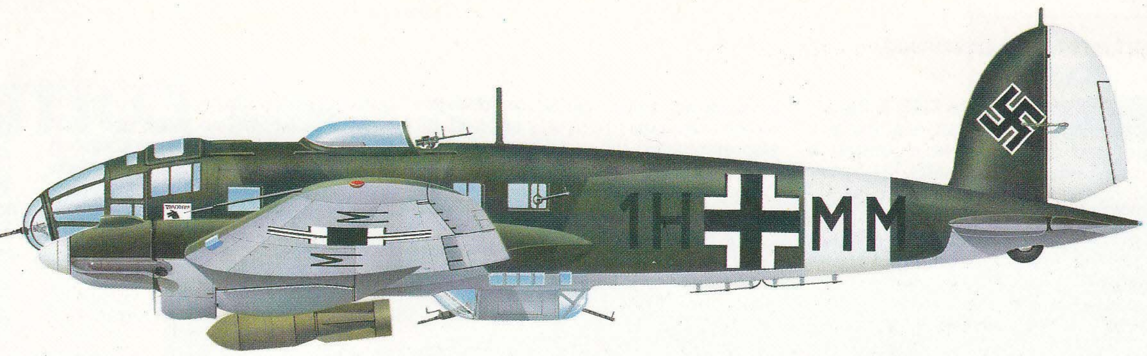
Longest-serving medium bomber of the Luftwaffe, the **Heinkel He 111** stemmed from a design by Siegfried and Walter Günther for a dual-purpose commercial transport/bomber produced in 1934 and flown on 24 February 1935. Early versions featured a conventional stepped windscreen and elliptical wing leading edge, and a bomber version with these features, the **He 111B-1**, served with the Legion Condor in the Spanish Civil War. The first production version with straight wing leading edge was the **He 111F**, and the **He 111P** incorporated a fully-glazed asymmetric nose without external windscreen step. He 111Ps with DB 601Aa engines were delivered to the Luftwaffe in 1939 before production switched to the most widely-used variant, the **He 111H** with Junkers Jumo 211 engines; sub-variants of this series formed the backbone of the Luftwaffe's bomber force between 1940 and 1943;

*Among the bomber units switched from the night assault on Britain to the Eastern Front in 1941 was KG 55 'Greif' (Griffon Wing), one of whose Heinkel He 111Hs is seen here being armed with an externally carried bomb prior to a raid.*



Heinkel He 111 (continued)

*From mid-1940 onwards, with the arrival in service of bombs too large to be carried internally, He 111s frequently carried their loads externally. A Heinkel He 111H-6 in the markings of KG 26 is shown.*



they took part in numerous raids in the Battle of Britain and were flown by the pathfinder unit, KGr 100. The first version to carry torpedoes was the **He 111H-6**, followed by the **He 111H-15**; the **He 111H-8** was fitted with a large and cumbersome balloon cable fender; the **He 111H-11/R2** was a glider tug for the Go 242, while pathfinder versions with special radio were the **He 111H-14** and **He 111H-18**; the **He 111H-16** featured increased gun armament, and the **He 111H-20** included 16-paratroop transport, night bomber and glider tug sub-variants. The **He 111H-22** carried a single Fi 103 flying bomb and was used against the UK late in 1944. The most extraordinary of all was the **He 111Z** (Zwilling, or Twin) which consisted of two He 111Hs joined together with a new wing and fifth engine; it was used mainly to tow the huge Me 321 Gigant gliders. A total of about 7,300 He 111s was built.

**Specification**
**Heinkel He 111H-16**
**Type:** five-crew medium bomber
**Powerplant:** two 1,350-hp (1007-kW) Junkers Jumo 211F inverted V-12 piston engines
**Performance:** maximum speed 436 km/h (271 mph) at 6000 m (19,685 ft); climb to 6000 m (19,685 ft) in 42 minutes; service ceiling 6700 m (21,980 ft); range 1950 km (1,212 miles)
**Weights:** empty 8680 kg (19,136 lb); maximum take-off 14000 kg (30,865 lb)
**Dimensions:** span 22.60 m (74 ft 1¾ in); length 16.40 m (53 ft 9½ in); height 3.40 m (13 ft 1¼ in); wing area 86.50 m$^2$ (931.07 sq ft)
**Armament:** one 20-mm MG FF cannon in nose, one 13-mm (0.51-in) MG 131 gun in dorsal position, two 7.92-mm (0.31-in) MG 15 guns in rear of ventral gondola and two 7.92-mm (0.31-in) MG 81 guns in each of two beam positions, plus a bombload of 2000 kg (4,409 lb) internally and 2000 kg (4,409 lb) externally

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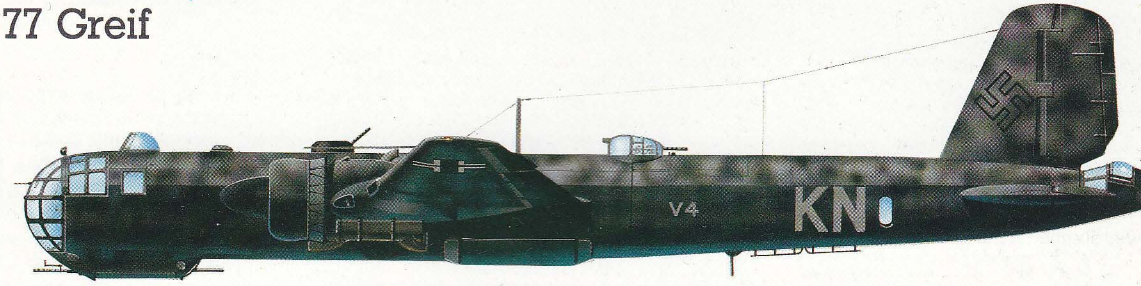
GERMANY

## Heinkel He 177 Greif

*Heinkel He 177A-5 of II Gruppe, Kampfgeschwader 1 'Hindenburg' based at Prowehren, East Prussia, mid-1944. KG 1 assembled about 90 of these bombers for attacks on Soviet communications and military installations, but unreliability dogged operations.*



After the scrapping of German plans for a strategic bombing force in 1936, the Luftwaffe abandoned plans to develop a heavy bomber until in 1938 the RLM approached the Heinkel company with a requirement for such an aircraft, resulting in the **Heinkel He 177 Greif** (Griffon), a four-engine mid-wing aircraft in which the 1,000-hp (746-kW) DB 601 engines were coupled in pairs (termed DB 606s) to drive single propellers. The first aircraft, the **He 177 V1**, was flown on 19 November 1939. Continuing engine overheating problems as well as persistent structural failures delayed production, the first **He 177A-1** not reaching I/KG 40 for operational trials until July 1942; in the course of these He 177s took part in raids on the UK, but generally they proved disappointing in service. Several subvariants of the **He 177A-3** were produced, including the **He 177A-3/R3** which could carry three Hs 293 anti-shipping missiles, the **He 177A-3/R5** with 75-mm gun in the ventral gondola and the **He 177A-3/R7** torpedo-bomber. He 177A-3s were used by KGr 2 to fly supply missions to the beleaguered German forces at Stalingrad in January 1943. The **He 177A-5** incorporated a stronger wing to carry heavier external loads, and a small number was converted to the Zerstörer role with 33 upward-firing rocket tubes in the space normally occupied by the bomb bays. Small numbers of He 177A-5s returned to the night attack on the UK early in 1944; this version proved to be the last to serve with the Luftwaffe (bombers being afforded low priority during the last year of the war), but many interesting projects continued to be pursued, including one involving the conversion of **He 177 V38** as a carrier of Germany's atomic bomb, which in the event did not materialize. About 1,160 production and 30 prototype He 177s were built.

**Specification**
**Heinkel He 177A-5/R2 Greif**
**Type:** six-crew heavy bomber
**Powerplant:** two 2,950-hp (2200-kW) Daimler-Benz DB610A-1/B-1 paired inverted V-12 piston engines
**Performance:** maximum speed 488 km/h (303 mph) at 6000 m (19,685 ft); initial climb rate 190 m (623 ft) per minute; service ceiling 8000 m (26,245 ft); range with two Hs 293 weapons 5500 km (3,418 miles)
**Weights:** empty 16900 kg (37,257 lb); maximum take-off 31000 kg (68,342 lb)
**Dimensions:** span 31.44 m (103 ft 1¾ in); length 20.40 m (66 ft 11¼ in); height 6.40 m (20 ft 11¾ in); wing area 102.00 m$^2$ (1,098.0 sq ft)
**Armament:** one 7.92 (0.31-in) MG 81 gun in nose, one 13-mm (0.51-in) MG 131 gun in forward dorsal turret, one 13-mm (0.51-in) MG 131 gun in rear dorsal turret, one 13-mm (0.51-in) MG 131 gun in rear of ventral gondola, one 20-mm MG FF cannon in front of ventral gondola and one 20-mm MG FF in tail, plus a maximum internal bombload of 6000 kg (13,228 lb) or two Hs 293 missiles

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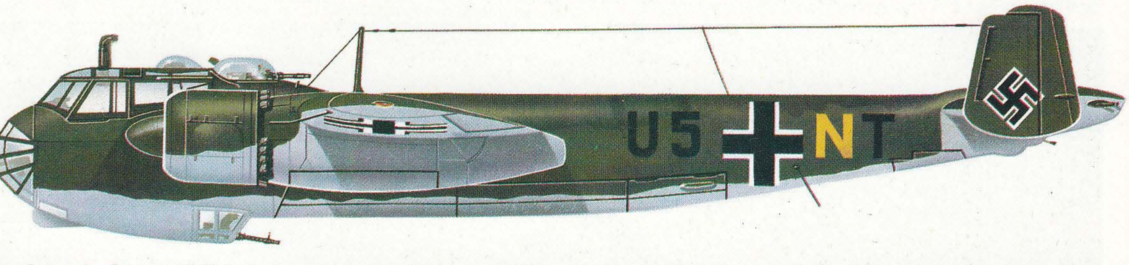
GERMANY

## Dornier Do 217

*In 1941 KG 2 re-equipped with Do 217Es; this Do 217 E-2 carries the codes of 9.Staffel. This version introduced an electrically operated dorsal turret with a single 13-mm machine-gun.*



In the normal process of design evolution it was recognised that, culminating from a design compromise, the Dornier Do 17 could at best represent a stopgap for three or four years in Luftwaffe service, and in 1937, as that aircraft was entering operational units, the manufacturer proposed a slightly larger and dedicated development, the **Dornier Do 217**.

Powered by 1,075-hp (802-kW) DB 601A engines, the prototype **Do 217 V1** was flown in August 1938 but at once showed that many of the excellent handling qualities of the earlier aircraft had disappeared; indeed, the prototype soon crashed. Several further prototypes followed with various modifications, including enlarged tail surfaces to overcome directional instability, but none received altogether favourable response from Luftwaffe pilots.

Eventual recourse was made to greatly increased engine power, and after limited production of the **Do 217A** reconnaissance aircraft and **Do 217C** bomber, a standard for full production settled upon the **Do 217E**, powered by two 1,550-hp (1156-kW) BMW 801MA radials. Pre-production **Do 217E-O** aircraft appeared in 1940, and service **Do 217E-1** bombers early in 1941; the latter carried a bombload of 2000 kg (4,409 lb), a crew of four or five, and a defensive armament of five MG 15 machine-guns and a 15-mm MG 151 cannon.

First to receive the Do 217E bomber, in March 1941, was II/KG 40 for anti-shipping duties over the Atlantic, followed by all three *Gruppen* of KG 2. A large number of sub-variants and *Rüstsätze* (field conversion kits) existed, including provision to carry two Henschel Hs 293 missiles, increased armour protection and armament progressively increased to seven MG 15s and a

20-mm cannon. The **Do 217E-2**, for example, introduced an electrically operated dorsal turret mounting a single 13-mm (0.51-in) MG 131 heavy machine-gun. Dornier Do 217Es of KG 2 constituted a large part of the Luftwaffe bomber force sent against British towns and cities in the so-called 'Baedeker raids' of April and May 1942.

During the autumn of that year a new version, the **Do 217K**, joined KG 2; powered by 1,700-hp (1268-kW) BMW 801D radials, this version was in effect a more powerful counterpart of the Do 217E series and could accommodate all the *Rüstsätze* previously applied; it also eliminated the windscreen 'step' by introducing a completely new and bulbous nose profile. Produced almost simultaneously was the **Do 217M**, which was similar to the Do 217K series but with 1,750-hp (1306-kW) Daimler-Benz DB 603A liquid-cooled inverted V-12 engines.

These two versions continued in service up to the end of the war, frequently being employed to deliver such weapons as the Hs 293A and Fritz-X both against ships and key land targets. However, no more than 1,730 Do 217s of all versions were produced, of which almost half were reconnaissance aircraft and night-fighters.

### Specification

**Dornier Do 217M-1**

**Type:** four-seat bomber

**Powerplant:** two 1,750-hp (1306-kW) Daimler-Benz DB 603A inverted V-12 piston engines

**Performance:** maximum speed 600 km/h (348 mph) at 5700 m (18,700 ft); initial climb rate 210 m (690 ft) per minute; service ceiling 9500 m (31,180 ft); range 2500 km (1,555 miles)

**Weights:** empty 9065 kg (19,985 lb); maximum take-off 16700 kg (36,817 lb)

**Dimensions:** span 19.00 m (62 ft 4 in); length 17.00 m (55 ft 9¼ in); height 4.96 m (16 ft 3½ in); wing area 57.00 m$^2$ (613.54 sq ft)

**Armament:** eight 7.92-mm (0.31-in) MG 81 and two 13-mm (0.51-in) MG 131 machine-guns, plus up to 4000 kg (8,818 lb) of bombs

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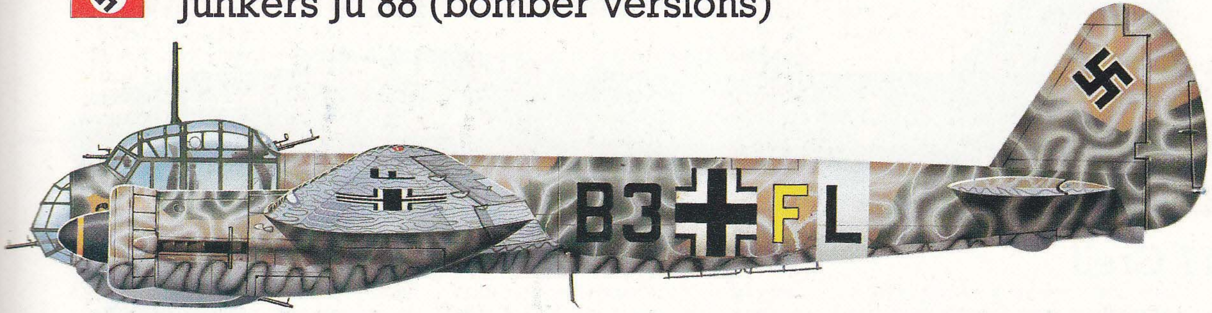
GERMANY

## Junkers Ju 88 (bomber versions)



*A disruptive white streaking was applied over the standard splinter Mediterranean camouflage of this Ju 88A-4 of I/KG 54 'Totenkopf, (Death's Head Wing) based at Bergamo, Italy, in September 1943 during operations against the Allies at Salerno.*

In terms of versatility and long service the **Junkers Ju 88** bomber matched the outstanding record of the Messerschmitt Bf 109 fighter. Conceived as a high-speed medium bomber in 1936, the first prototype **Ju 88 V1** was flown by Flugkapitän Kindermann at Dessau on 21 December the same year. The three-seat all-metal aircraft was originally powered by two 1,000-hp (746-kW) Daimler-Benz DB 600A V-12 engines in annular cowlings. Nine further prototypes followed before construction of 10 pre-production **Ju 88A-O** aircraft was started in 1939, by which time the nose and cabin had been revised to accommodate a four-man crew. Dive brakes were now fitted under the outer wings to enable dive attacks to be made, and external bomb racks under the inner wings increased the bomb load from 500 kg (1,102 lb), carried internally, to a total of 1500 kg (3,307 lb).

Production **Ju 88A-1** bombers were joining the Luftwaffe at the outbreak of war, and about 60 aircraft had been completed by the end of 1939. The Ju 88 test unit commanded by Hauptmann Pohl, Erprobungskommando 88, was redesignated I/KG 25 in August 1939, and the following month became I/KG 30, carrying out its first operation with an attack on British warships in the Firth of Forth on 26 September. A further raid on the same target followed on 16 October, when two Ju 88s were shot down by Supermarine Spitfires.

By the time of the German invasion of Norway seven *Gruppen* of LG 1, KG 30 and KG 51, together with Aufklärungsgruppe 122, had been equipped or were re-equipping with Ju 88As, production of which was nearing 300 a month. New bomber variants included the **Ju 88A-2** with rocket-assisted take-off gear, the **Ju 88 A-4** with increased wing span, strengthened landing gear and 1,340-hp (1000-kW) Junkers Jumo 211J-1 or J-2 engines, and the generally similar **Ju 88 A-5**. All these versions appeared during 1940, the Ju 88A taking a prominent part in the summer Battle of Britain and winter Blitz with 17 *Gruppen*, of which 14 were *Kampfgruppen*. By reason of their relatively high speed, the Ju 88As proved the most difficult of the German bombers to destroy, and carried out a number of very successful attacks.

The Ju 88A series remained the principal bomber version, later sub-variants including the **Ju 88A-6** with balloon cable fender, the **Ju 88A-6/U** three-seat long-range maritime bomber with FuG 200 *Hohentwiel* search radar, the **Ju 88A-9, Ju 88A-10** and **Ju 88A-11** which were tropicalized versions of the Ju 88A-1, Ju 88A-5 and Ju 88A-4 respectively, the **Ju 88A-14** anti-shipping strike bomber, the **Ju 88A-15** with bulged bomb bay capable of enclosing 3000 kg (6614 lb) of bombs, and the **Ju 88A-17** torpedo-bomber.

Ju 88As saw considerable action in the Balkans and Mediterranean, and of course on the Eastern Front. Perhaps their most outstanding service was however with III/KG 26 and KG 30 when based in northern Norway for operations against the Allied North Cape convoys in 1941-2; in all, the 120 Ju 88As involved are estimated to have sunk 27 merchant ships and seven naval vessels. Ju 88As of LG 1 operated with similar success against the Malta convoys during the summer of 1942.

Towards the end of the war many redundant Ju 88As were converted to become the unmanned, explosive-filled component of the *Mistel* composite aircraft weapon that was used with some success in the last desperate months of the Third Reich.

### Specification

**Junkers Ju 88A-4**

**Type:** four-seat medium/dive bomber

**Powerplant:** two 1,340-hp (1000-kw) Junkers Jumo 211J-1 or 211J-2 inverted V-12 piston engines

**Performance:** maximum speed 450 km/h (280 mph) at 6000 m (19,685 ft); climb to 5400 m (17,715 ft) in 23 minutes; service ceiling 8200 m (26,900 ft); range 2730 km (1,696 miles)

**Weights:** empty 9860 kg (21,737 lb); maximum take-off 14000 kg (30,865 lb)

**Dimensions:** span 20.00 m (65 ft 7½ in); length 14.40 m (47 ft 2⅔ in); height 4.85 m (15 ft 11 in); wing area 54.50 m$^2$ (586.63 sq ft)

**Armament:** up to seven 7.92-mm (0.31-in) MG15 or MG81 machine-guns, plus a maximum internal and external bombload of 3600 kg (7,935 lb)

*The Ju 88 served in the bomber role throughout the war and in every theatre. This Ju 88A is seen in the North African desert (note the white theatre band on the rear fuselage) with a pair of 250 kg (551 lb) bombs under the wings, inboard of the engine nacelles.*

# South Africa

## Part 2

### South African Air Force

*Although South Africa does have an air defence requirement, her Mirage IIIs are mostly optimized for ground attack. Here a Mirage IIIEZ fires a salvo of unguided rockets at a ground target.*

That South Africa is at war only becomes apparent when terse statements are released by the military authorities referring to losses in the 'operational area'. The battles are usually in Angola and more recently in Namibia, but surrounded as South Africa is by black African states, they could involve clashes between guerrillas and the South African defence forces in any one of the neighbouring countries. But for the disorganization and divided loyalties of the opposing armies, losses to date could have been far higher for this last white-ruled African nation.

Yet the South African forces continue to maintain their position as the strongest and most modern army in southern Africa, despite the UN anti-apartheid sanctions. It is generally accepted that the republic is now about 90 per cent self-sufficient in arms production, manufacturing within its borders anything from bullets to bomber aircraft. The equipment it cannot produce comes through the sanctions-busting 'back door' with no questions asked.

The South African Air Force is technically the strongest element in the country's defence network. Its personnel are trained to the highest standards to operate a range of modern combat and support aircraft. Spearheading the front-line force within Strike Command are more than 40 Dassault-Breguet Mirage F.1s and 40 Dassault-Breguet Mirage IIIs assigned the air superiority and fighter-bomber roles. Most of the Mirage F.1s were assembled in South Africa by Atlas Aircraft from French-supplied components, and speculation continues over whether or not more of these capable aircraft have actually been built by Atlas than officially declared. As a staunch supporter of the UK, South Africa bought 'British' for many years, and reminders of this happier period are the six English Electric Canberra and six Blackburn Buccaneer bombers which still equip two SAAF squadrons. If, as some experts argue, the country has developed a nuclear weapon, it seems highly probable that the delivery system would be the Buccaneer.

The important sea lanes around South Africa are regularly patrolled by seven Avro Shackleton MR.Mk 3s of Maritime Command. These old aircraft have been virtually rebuilt to keep them flying, but their replacement is now a matter of some urgency. It is believed a maritime reconnaissance version of the French Transall is being developed for this purpose. Supplementing the Shackletons are 20 Piaggio P.166S Albatrosses which perform the short-range coastal patrol task.

Air Transport Command has a mixture of American, French and British aircraft. Numerically, the Douglas C-47 heads the list, with more than 40 in use acquired over a number of years from a variety of sources. The heavy-lift component comprises seven early Lockheed C-130B Hercules transports delivered in 1963, but this force can be expanded to incorporate 11 Lockheed L-100 civil variants operated by the freight airline Safair. These aircraft carry civilian registrations but are often manned by military crews. Shorter-range tactical missions are flown by nine Transall C-160s. Flying on VIP and communications duties are seven Douglas DC-4s, four Swearingen Merlin IVs, four BAe HS.125s and a single Vickers Viscount.

Within Light Aircraft Command, headquartered at Zwartkop, are 10 squadrons with helicopters and fixed-wing support aircraft. The helicopter units are wholly French-equipped, the largest type in use being the Aérospatiale Super Frelon, of which there are 14 of 16 delivered, divided between two units. More than 60 Aérospatiale Alouette IIIs operated for gunship, medevac and liaison tasks. Home-produced Atlas Bosbok (the Italian AM.3C built under licence) and Atlas Kudu single-engined liaison and light transport aircraft respectively, make up the majority of the fixed-wing force totalling some 80 machines. The rugged Cessna Model 185 remains in use in one or possibly two squadrons.

The high quality of SAAF training is a telling fact on operations. Training Command encompasses the Central Flying School at Dunnottar, one Flying Training School at Langebaanweg and four Advanced Flying Schools. Equipping the FTS are more than 100 Atlas Impala Mk Is (licence-built M.B.326s) plus a few of the 70 or more single-seat Impala Mk IIs built. Each of the AFS units trains pilots for a specific role: No. 84 AFS for light aircraft. No. 85 AFS for fast jets, No. 86 AFS for multi-engine and No. 87 AFS for helicopters.

Two other elements play an important role within the SAAF. The first is the Active Citizen Force, made up of six auxiliary squadrons equipped with Impala Mk II light strike aircraft. There are also 13 Air Commando Squadrons (Nos 101 to 112, plus No. 114 Women's ACS) under the control of the SAAF and flying civil light aircraft for use in emergencies.

*Support of the South African Army is a prime obligation of the Air Force, and they fly a substantial number of helicopters in that role. The Aérospatiale Super Frelon has served well for many tough years, but still soldiers on.*

### South African Air Force order of battle

One medium bomber squadron (Canberra B(I).Mk 12/T.Mk 4)
One long-range strike squadron (Buccaneer S.Mk 50)
Three air-superiority/fighter-bomber squadrons (Mirage F.1AZ/F.1CZ, Mirage IIICZ/BZ/RZ/R2Z)
Five light attack squadrons (Atlas Impala Mk I)
One long-range maritime reconnaissance squadron (Shackleton MR.Mk 3)
One coastal patrol squadron (Piaggio P.166S Albatross)
One anti-submarine helicopter squadron (Wasp HAS.Mk 1)
Four transport squadrons (C-130B Hercules, Transall C-160, C-47 Dakota, DC-4)
One communications/liaison squadron (Merlin IV, Viscount, HS.125)
Four utility/light transport squadrons (Cessna 185, AM.3C Bosbok, C4M Kudu, Alouette III)
Seven transport helicopter squadrons (Super Frelon, Puma, Alouette III)
Five flying schools/operational conversion units (Mirage IIIEZ/DZ/D2Z, Cessna Model 185, C4M Kudu, AM.3C Bosbok, Impala Mk II, T-6 Harvard)